

2a

2/p/5mc/147

HOUSE OF EDUCATION, AMBLESIDE.

NAME K. Hugman

DATE May 8<sup>th</sup> 1922 ~~FOR~~

SUBJECT ~~Botany~~ & Natural History.

E.S.A. LONDON



## Botany

Cruciferae (cross-bearing family)

### Characteristics

Cruciform flower

in Botany Bk.

Tetradynamous stamens.

Fruit, a silique.

May 18<sup>th</sup> '22

The Horse chestnut leaf consists of 5 or 7 leaflets springing from a common base. Each leaflet is oval shaped & pointed slightly at the apex. The margin is indented - pointed teeth.

The Rose leaf consists of a number of leaflets (generally 5, 7, or 9) springing from different parts of the stem. They are pointed & widen towards the base & curl in again. Each has very pointed teeth.

The ~~shape~~<sup>margin</sup> of the dandelion leaf is described as serrate. It has a rounded top & has two large rounded teeth on each side.



a broad base.

The beech leaf is ovate in shape - almost a heart upside down. Its margin is slightly indented with blunt teeth. It is also covered with silky hairs.

The daffodil leaf is linear - that is its two sides are parallel, & its margin is entire.

The ivy leaf is <sup>5</sup>tri-lobed - each lobe is pointed & the margin is entire.

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June 9<sup>th</sup> '22

Hypogynous flowers (1) Wallflower, Rhododendron.

Hypogynous, but flattened receptacle (1) Bird's Eye

Perigynous (3) ~~Pimpernel~~, figwort, apple

Epigynous Cow parsley, Daffodil.

Whorls arranged spirally

Internodes between calyx & corolla

scilla & stamens

Trimerous Lily of the Valley

Pentamerous Primrose, Camassia

Tetramerous Wallflower, Linum

odd sepals antlers Broom



Longitudinal Section of Rhododendron.

Stamens opposite petals:

Absence of perianth: Willow

One whorl of stamens: Primrose

More than two: Ranunculaceae.

Very fair

Cont. in Botany Book.







ilp 7 cmc 147

There is a theory that a lichen is a mixture of fungus & alga, <sup>the first</sup> ~~where both~~ parasitic & dependent on the other. This may be so, for it is quite true that a lichen can grow where neither a fungus nor an alga can grow by itself. But this theory is still under discussion.

There are 3 modes of reproduction:-

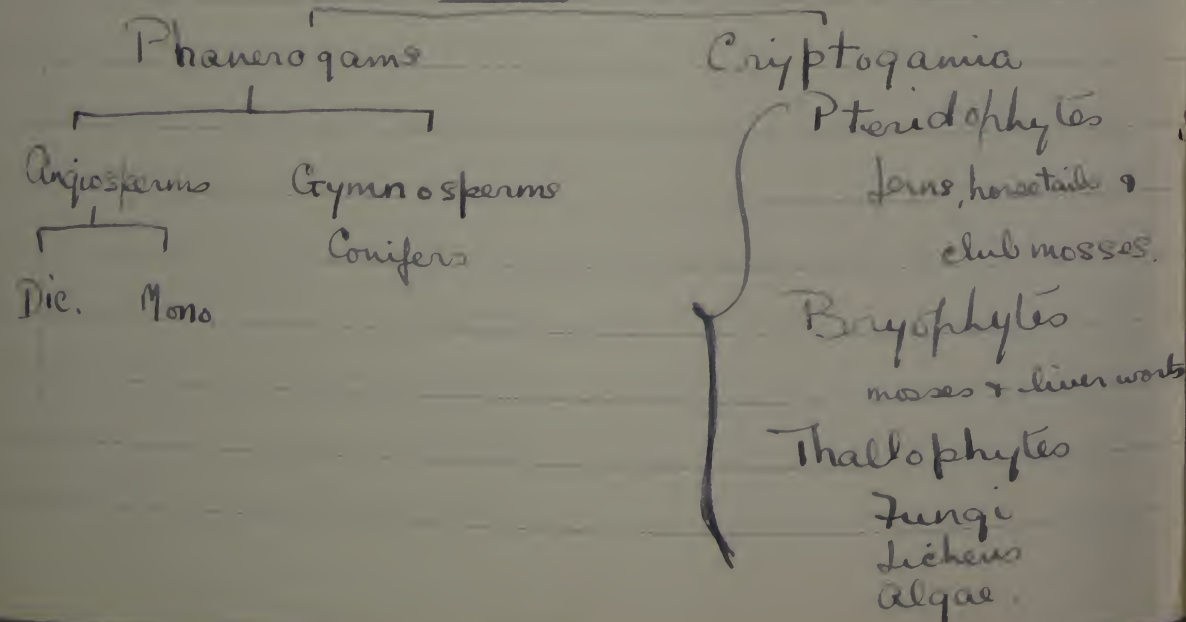
1. by Spores - squeezed up on to the coloured surface by the sterile cells

2. by soredia

3. by fragments. Good but the writing needs improvement

## Algae.

July 3<sup>rd</sup>



ilp 8 cmc 147

Algae vary greatly in size - as a group. Some are microscopic, others reach great size. Unlike other plants they do not possess vascular bundles - or true roots, leaves or stems.

Whole plant body is a ~~thallus~~ thallus. A great proportion of the algae are seaweeds. These are classified according to their shores, which are the same colour as the seaweed itself - Green, brown & red. Brown grows between high & low water so that it is not long out of water. The red is never out of water, as it cannot grow except in the water. It is seen that the colours are, according to the plant's relation to the light. The green algae has therefore, the greatest amount of sunlight.

Diatoms are useful for testing microscope lenses. They are very slippery. Many algae are found in fresh water - such as Desmids.

Other ~~the~~ groups of Algae are -

1. Blue-green algae, which are red, & give the colour to the Red Sea

2. Green algae.

Green laver - one of the Conjugatae, looks like lettuce.



21p9 emc 147

Chara (Tarn Haws)

Spirogyra

Diatoms & Desmids - (one celled)

### III. Brown Algae

Fucus or bladder wrack

Laminaria or seaweed

Sargasso weed

### IV. Red Algae

Delesseria

Rhodanthera

## Dispersion of Seeds

Oct. 16<sup>th</sup>

### By Mechanical means -

balsam

violet

Broom

herb robert

lesser hairy capentress

wood sorrel

squirting cucumber

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### By wind

#### Wings

fruits

Sycamore

Maples

ash

hornbeam

elm

birch

Umbelliferae

lime

seeds

pine

fir

larch

honesty

#### Pappus

fruits, seeds

Dematis

willow

dandelions

willow herb

other Compositae

bulrush

cotton grass

marsh valerian

kumble weeds

long stalked capsule: e.g. poppy

campion

### Birds or Animals

#### Hoofs

hind

goosegrass

avena, hand's tongue

teasel

agrimony

enchant's nightshade

wood sanicle

foal's head melick medick

forget-me-not

#### fleshy or edible

hips

blackberries

raspberry

haw

cherry

holly

sloe

apple

hazel

beech

chestnut

acorn

seed

walnut

sticky

mistletoe

R



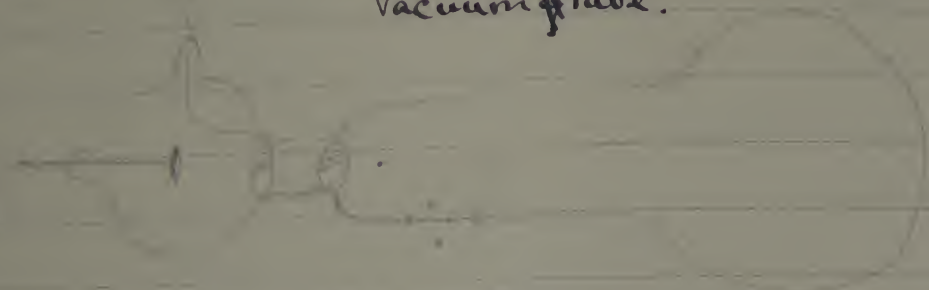
New Red Sandstone.

Oct. 17<sup>th</sup>

Found on top of the Carboniferous rocks.  
Buildings: - Carlisle, New Liverpool Cathedral

Oct. 30<sup>th</sup>

vacuum tube.



Sir William Crookes

The bombardment of electric <sup>particles</sup> atoms passing through the further end of the vacuum tube is called cathode rays or electrons. The particles are shot off from the metal & travel in a straight line to the bulbous part of the tube & make it phosphorescent. If a magnet or other drawing force be placed beneath the tube, their course is deflected downwards. If a cross or

something to that effect be placed in the narrow part of the tube, its shadow will be seen on the bulb as the electrons have passed by the arms of the cross but naturally could not pass through it. Also, if a small windmill or vane be placed inside the tube the high speed of the electrons causes it to turn. If a window of aluminium foil be placed in the bulb the electrons pass out through this & make the air outside luminous, but the air outside has too great a force to let the electrons go farther than an inch or two away.

Electrons move at an enormous speed - varying from 5,000 to 60,000 miles per second. (Light: 186,000 m.p.s.).

Radium is the heaviest but one of the elements. It was discovered in 1898. Three kinds of rays are given off by radium. The first two kinds are thought to be forms of matter. The third are X-rays.

1. 18,000 m.p.s. on striking certain matters they give off tiny sparks of light. twice as big as atom of hydrogen.



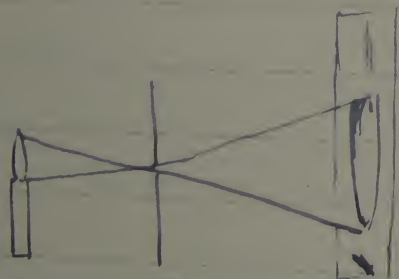
2. Usually called electrons & help us most in discovering the composition of the atom. 1000 times smaller than an atom of hydrogen.

There is some force holding the electrons together to form the atom. (e.g. force of gravity & solar system). This may be shown by experiment - with <sup>large</sup> magnet & several small ones in water drawn together to form shape according to number.

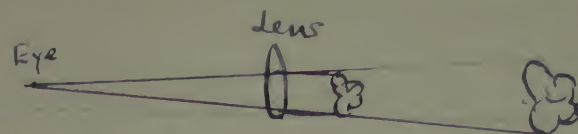
## Light.

Nov 13<sup>th</sup>

1. Light travels in straight lines
2. " can be refracted
3. " " reflected
4. " travels at a <sup>velocity</sup> speed of 186,000 m.p.s.



2. Rays are bent when they travel through denser mediums. Lenses etc. e.g.



Eye or mind expects a straight line. Light causes vibrations in the ether (waves).   
 → wave length → ray of light.

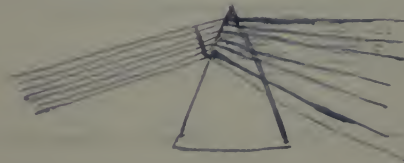
Longest ether waves are the electric ones. Shortest one is <sup>wh. has been used</sup> 1/6 inch. These are of course enormous to the ordinary rays of light.

30,000" = dark heat which we can only feel.

White light consists of 7 colours. They vibrate at different velocities. e.g. <sup>some</sup> wave lengths are longer than others.

34,000" red waves, 6,000" violet waves

There is also ultra-violet light which cannot be seen. X rays <sup>have an</sup> are even smaller than this. Red, orange, yellow, green, blue, indigo & violet.



Red are slowest, violet the fastest. Shortest ultraviolet wave measured = 1/10,000 of a mm.



3. Reflection Some colours attract light & others absorb it. Every colour is begun by the electrons in the molecules.

Sound.

Dec. 4<sup>th</sup>

Sound.

Light

Vibrations in air  
 $\frac{1}{5}$  m. p. s. or 1 m. in  
 5 sec. (roughly)

Vibrations <sup>in</sup> of aether  
 186,000 m.p.s.

Sound is transmitted much <sup>also water</sup> more clearly through solids than just air. Wood iron. Most gasses transmit sound as well as ordinary air. Water, 4 times as fast. Iron 15 & Wood 10.

Molecules act like trucks on a railway line - For instance

- each successive lot hits the next & gives it a push on. Wave length is measured from one region of compression to the next

(Different wave lengths).

In light - Colour depends on wave length

In Sound - Pitch depends on wave length.

6 1/2 ft long & 16 in a sec. (lowest we can hear)

1/3 inch long & 38,000 per sec. (highest)

Shorter the wave, higher the pitch.

87 per sec. lowest in man's voice

768 - highest - woman's

Vibrations of regular length & evenly, produce musical sounds.

String vibrating -

1. as a whole - produces the fundamental note
2. in halves - octave to F.
3. in thirds - fifth to no 2.
4. in quarters - two octaves to F.
5. in fifths - major 3<sup>rd</sup> to no 4.

also similarly higher up.

gases transmit



Spring Term 1923

2/p 17 cmc 147

## Classes of the animal kingdom

1. Protozoa - { Protos = first  
                  { zoön = animal  
                  unicellular, microscopic forms
2. Coelenterata - { Koilos - hollow  
                      { enteron - intestine  
                      Jelly-fish, Sea anemones etc
3. Echinodermata

2/p 18 cmc 147

Jan. 29<sup>th</sup>

The Protozoa are more or less Protoplasm. (Protos - first & plasma - form) Nothing can live without protoplasm. Protoplasm multiplies by splitting in two at the nucleus. Every cell is filled with protoplasm.

Amoeba are about the simplest protozoa. They live ~~at~~ in muddy ponds. Also Thread slimes - Rhizopods. These have no definite shape or mouth. Infusoria have a more or less definite shape & mouth.



2/p 19 cmc 147

Autumn Term 1923. Astronomy.

October 2<sup>nd</sup>

Apparent motions of the sun

rising & setting

length of days & nights

Seasons

Climate

- Earth's rotation  
- Earth's revolution in  
orbit & inclination of  
axis. Distance from  
sun.

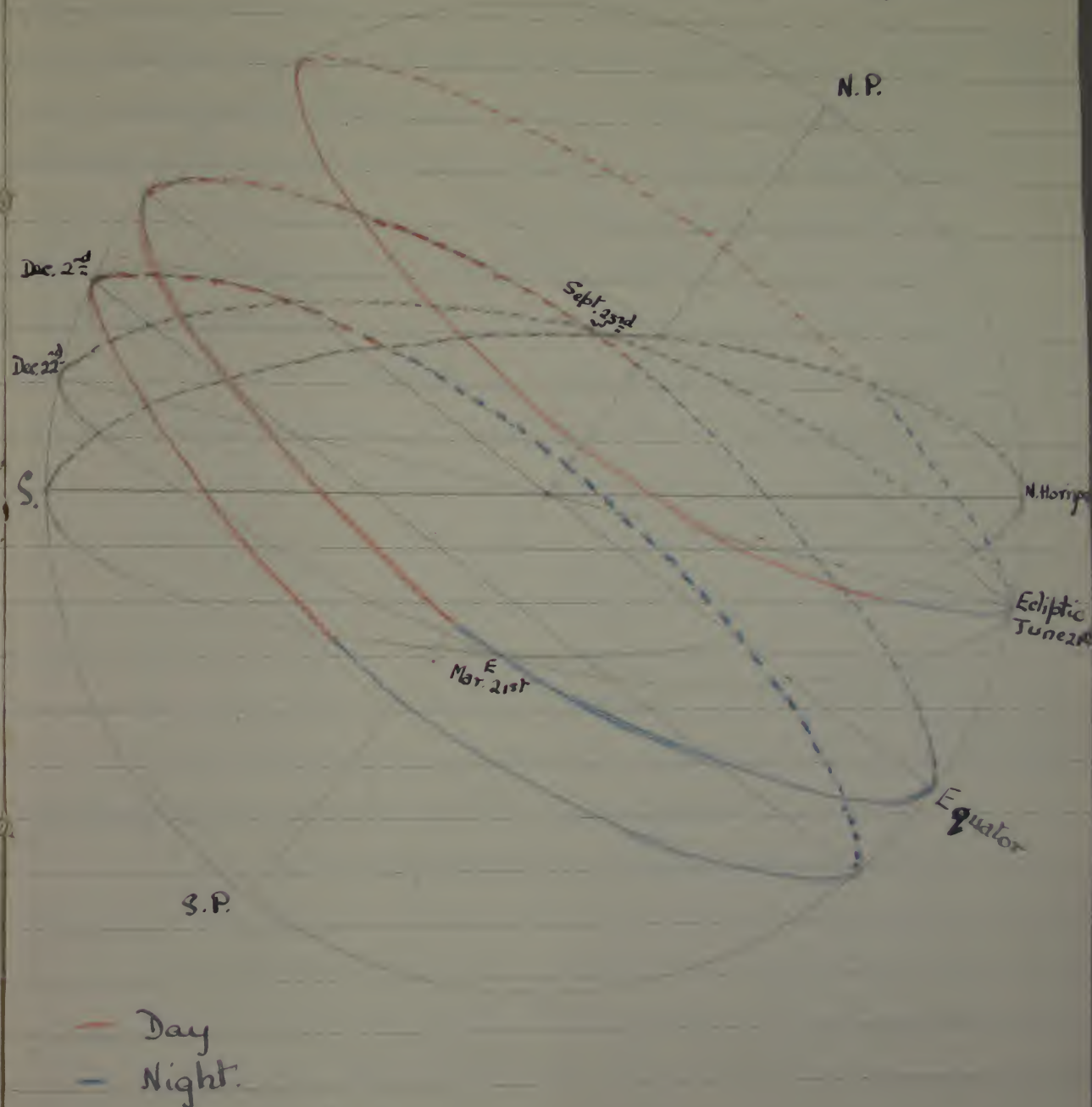
Southern summer is hotter than northern  
summer - the sun is in 'focus'.



The ecliptic is the plane of the Earth's orbit or  
the apparent path of the sun.

2/p 20 cmc 147

Celestial Sphere for an observer at a latitude of  $54^\circ$ .









but the partridge can afford to have small eggs because she is more like a hen & is prepared to take more care of her young than is a snipe.

A Guillemot is ~~as~~ the size of a raven, but its egg is about 10 times as large. This egg is the size of that of the eagle, which proves that the eagle's egg is small comparatively.

4. Birds of prey
5. Perchers - (half of all the known birds)
6. Scratchers - partridge etc
7. Climbers - eg. woodpeckers, nuthatch.

Two divisions into which all birds may be divided are those with

1. a keeled breast bone - flying birds &
2. a raft-like or flat breast bone - running birds (ostrich, emu, Rhea, moa etc)

## Astronomy.

Oct. 16<sup>th</sup> '23

### Constellations in the Zodiac.

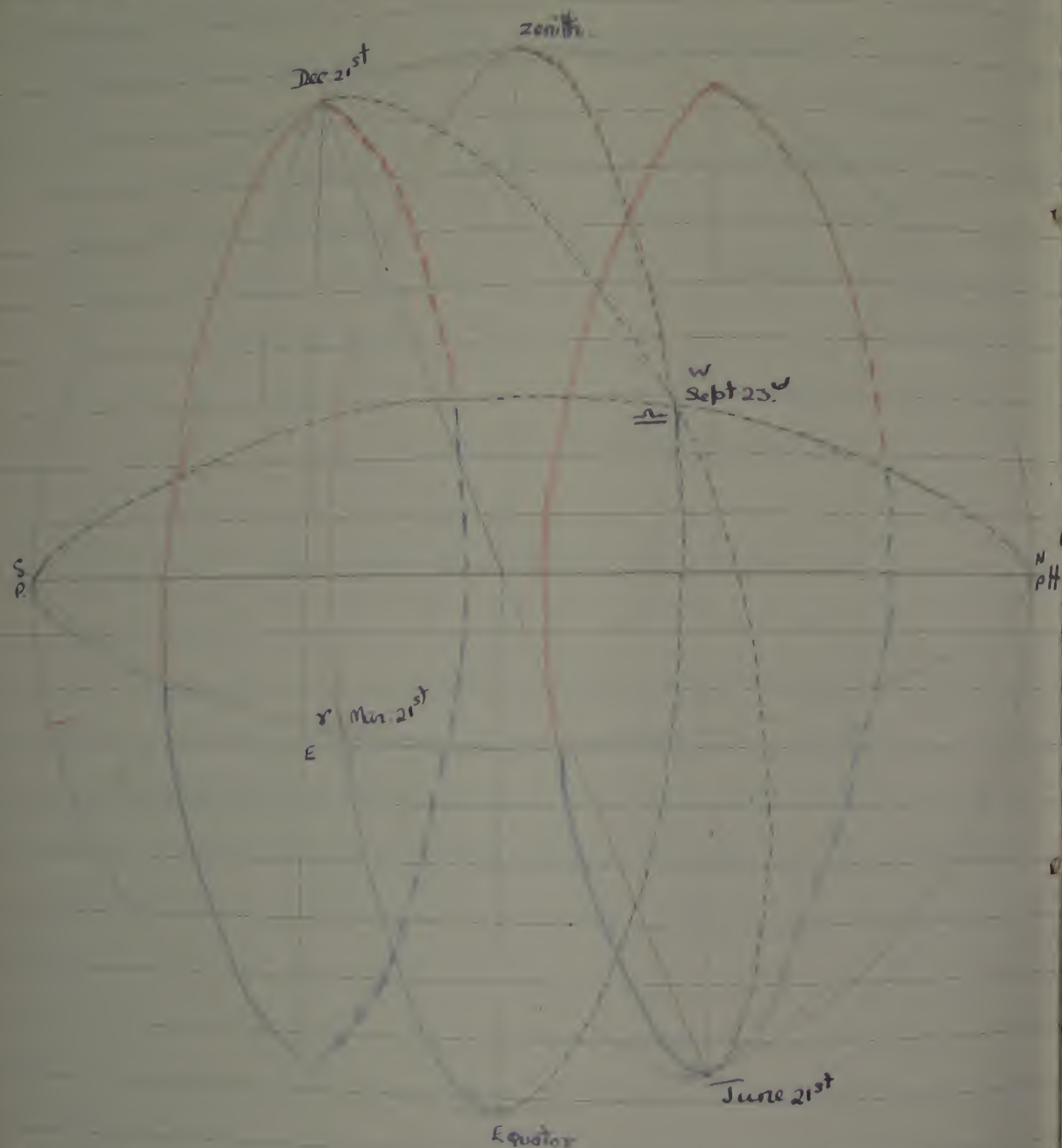
♈ Aries	♎ Libra
♉ Taurus	♏ Scorpio
♊ Gemini	♐ Sagittarius
♋ Cancer	♑ Capricornus
♌ Leo	♒ Aquarius
♍ Virgo	♓ Pisces.

The Ram, the Bull, the Heavenly Twins,  
And next the Crab, the Lion shines,  
The Virgin & the Scales,  
The Scorpion, Archer & the goat  
The man who bears the watering pot  
And Fish with glittering tails.



i/p 25 cme 147

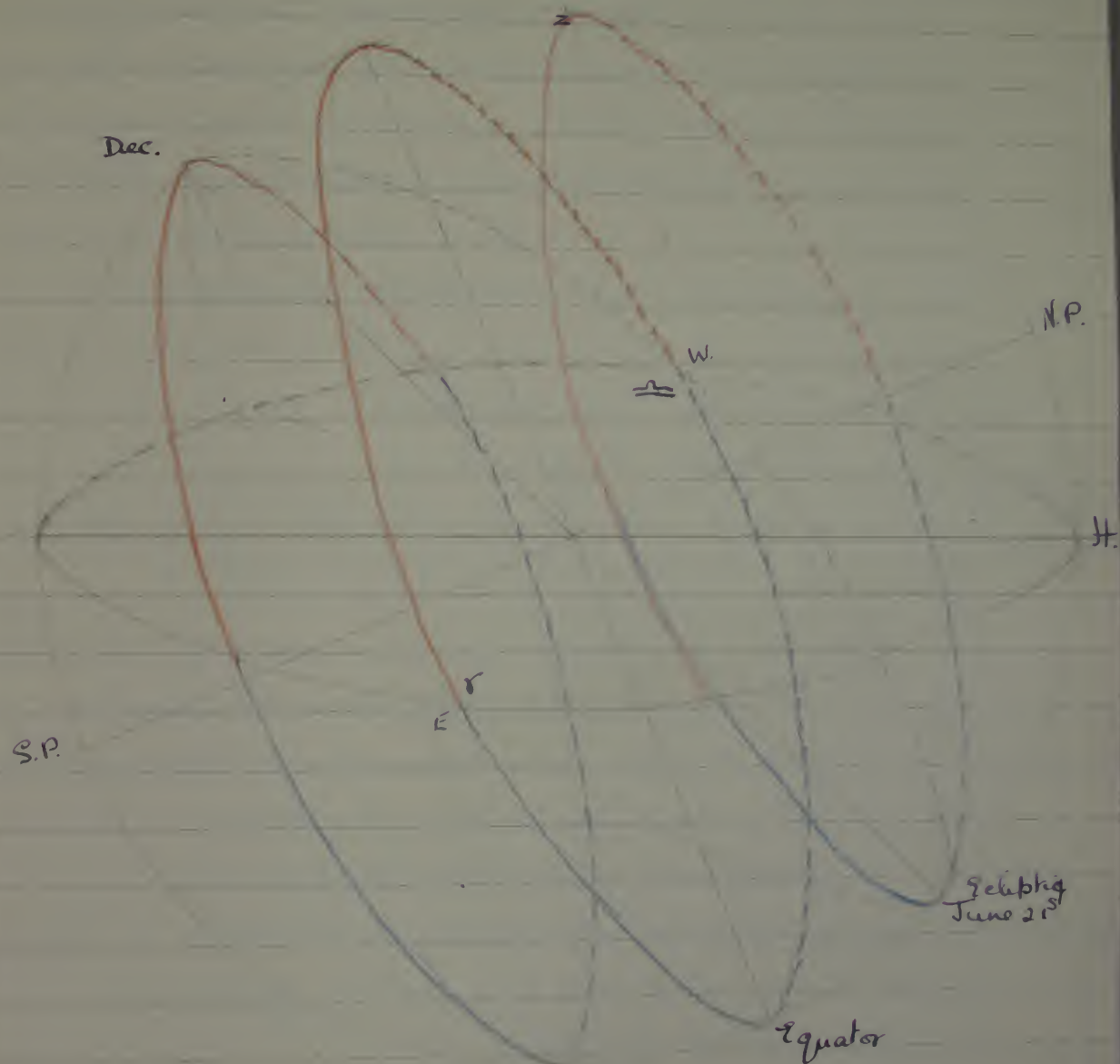
# Celestial sphere for an observer at the Equator



Days & nights are equal; sun is always overhead.

i/p 26 cme 147

# Celestial Sphere for an observer at the Tropic of Cancer



V. 9.



Architecture

@ch. 22<sup>nd</sup>

From ἄρχη = chief τέκτον = art.

Architecture is influenced by the climate & the material in the place.

Great things to remember are: proportion; light & shade.

Aim of architect to unite utility & beauty.

Roofing is usually in one of two ways:

1. Arches - with small stones

2. Beams - with large stones.

*Did not say this?* The Greek style was largely derived from the  
Tuscan & applied to vaults & doors.

ex. in London: National gallery, front of Euston station.

Roman arches: Marble Arch, Arc de Triomphe.

The dome is the characteristic of Roman style.

St Paul's, Les Invalides, Pantheon.

Bysantine & Roman styles are contemporary & are both included in the name Romanesque, a name for all round arched styles.

In England now there are chiefly either Saxon or Norman.

The Saxon is the earliest native style & there are very few remains. What there are, are mostly towers. The chief characteristics are:

Triangular heads of windows in towers

Small balusters

long & short work in angles.

Narrowness & lowness.

[old church at Ripon 670 a.d.]

Norman oldest church in London is that of St. Bartholomew the Great. Bayeston nr. Dover is Norman 1000 a.d.

(Semi circular Round headed) arch

Pillars - solid

Windows - round headed, thick walls

Three divisions from floor to roof: Clerestory

Triforium

Nave arcade.

Ornaments: billet  or zigzag  mouldings.

capitals - square blocks of stone with cushion underneath (cutting corners of a square block)

doors

Good but the drawings are too sketchy.



# Astronomy

@ Oct. 23<sup>rd</sup> '23

Moon's diameter : 2,000 miles.

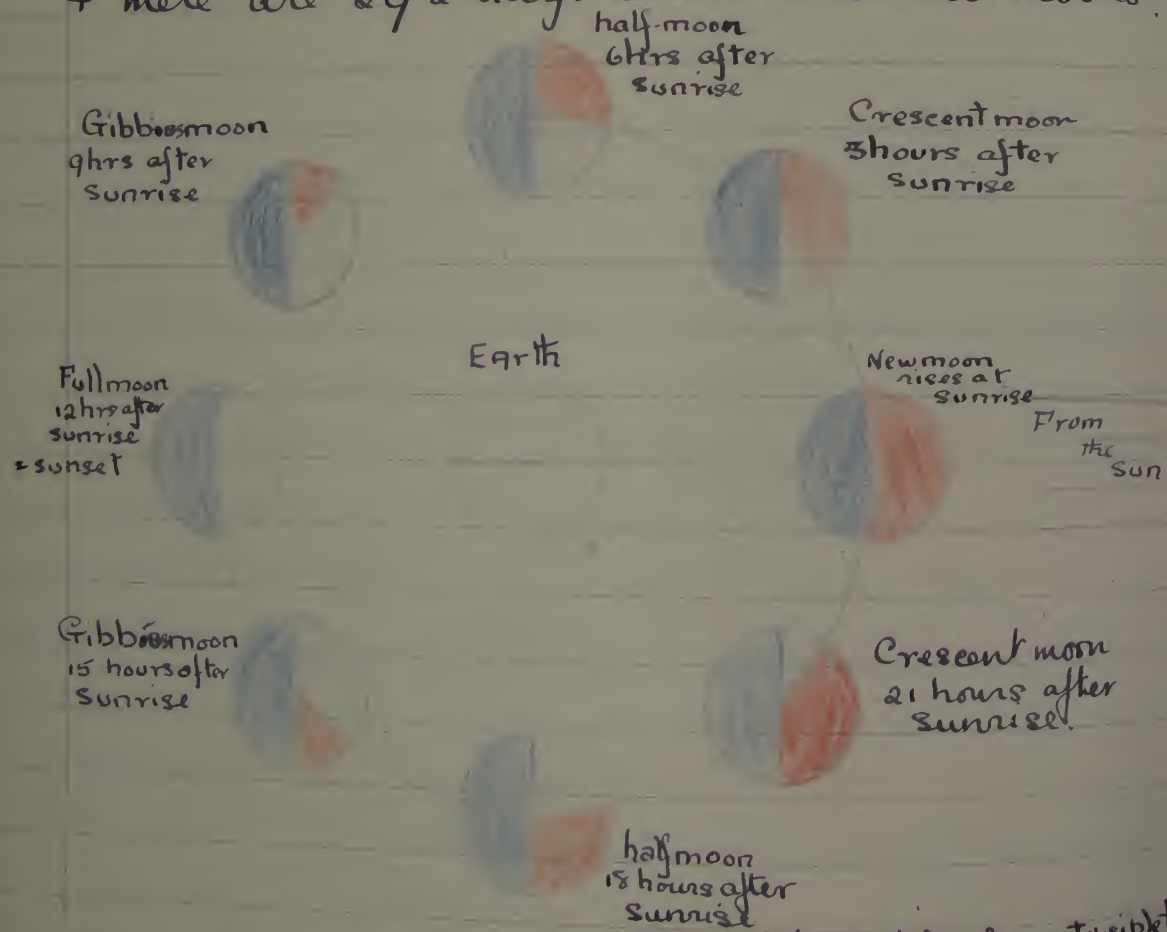
240,000 miles from the earth.

Moon's light is reflected from the sun.

New moon rises with the sun.

Full moon rises at sun-set.

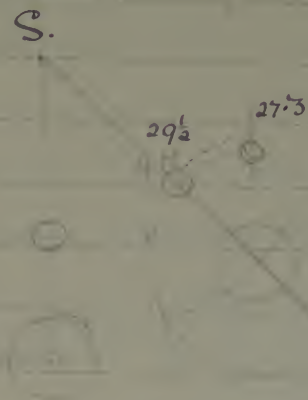
The moon takes 27.3 days to go round the earth,  
+ there are 29½ days between 2 new moons.



Phases of the moon. Key to diagram:

illuminated surface not visible to earth  
" " visible to earth  
darkened surface of moon

Moon's rotation in one month same as time it takes to go round the earth.



Showing why there are 29½ days between 2 new moons.

Good. The big diagram is inspired by reading.

# Architecture.

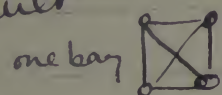
Oct. 29<sup>th</sup> '23.

Cathedrals 1060-1150 or 1170	Churches of Benedictine Monasteries
Canterbury 1072	St Albans 1077-1093
Rochester 1077-1137	Gloucester 1080-1100
Winchester 1079-1093	Peterborough
Ely 1081-1103	Southwell 1130
Worcester crypt 1084	Abbeys etc.
Chichester 1091-1114	Bury St Edmunds.
Durham 1104-1123	Tewkesbury 1107
Nottingham 1096-1101	St Bartholomew 1123
Exeter towers 1107	

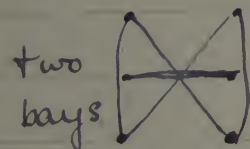


Abbeys etc *ilp31cmc 147*  
 Romsey  
 Christchurch 1050  
 Wimborne 1043  
 Furness 1090.

Earliest Roman vaulting was at Durham.  
 Simple groined vault. "plough share".  
 Ribbed vault



quadripartite vault.



sexpartite vault

Astronomy

Oct. 30th '23

Sun

moon Conjunction

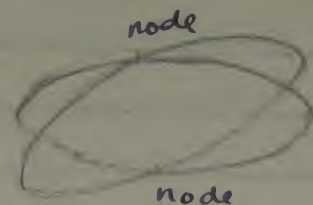
Earth

Opposition

moon

*ilp32cmc 147*

5° angle made by the moon's orbit with the ecliptic



total

An eclipse occurs only at the nodes. As the nodes are always <sup>total</sup> shifting, eclipses of either the moon or sun are rare.

The Saros, a period of 18 years or 223 lunar months or 6585 1/3 days, a cycle of eclipses.

During this time there are 45 solar & 25 lunar eclipses.

There must be 2 eclipses in a year & may be 7.

Three kinds of solar eclipse: Total, Partial & Annular.

Diagram showing the Eclipses.

penumbra

umbra

penumbra

The penumbra receives light from (one) part of the sun.



An Annular eclipse <sup>takes place</sup> is when the moon is apparently smaller - i.e. is farther away from the earth (orbit is an ellipse) - & it is not apparently large enough to cover the entire sun, but we may see a ring of the sun outside it.

Good



## Astronomy.

Nov. 6<sup>th</sup>

### The Solar System

Mercury	♂	} Inferior planets. (between earth & Sun)
Venus	♀	
Earth	⊕	
Mars	♂	
Asteroids		
Jupiter	♃	
Saturn	♄	
Uranus		
Neptune		
Satellites		

### Ellipses.



### Kepler's Laws.

I The orbits of the planets are ellipses with the sun in one of the foci.



Position of Planets according to P. ~~to~~lemy 100-170 AD  
(2) Copernicus 1473-1543

Stars

Saturn

Jupiter

Mars

(1) Sun (2) Earth

Venus

Mercury

(Moon)

Earth

1 Sun

4 Opposition (Superior planet)

⊕

♀ Inferior Conjunction

3

♀ Superior Conjunction

4 Conjunction

Planets move

shine by reflected light

have phases.

Inferior planets transit

Tycho Brahe d. 1601 made an enormous amount of observations <sup>for 20 years</sup>. Kepler (1571-1630) was his pupil & he made use of his master's notes & by "mathematical deductions discovered that the orbits of the planets are not circles but ellipses"

Architecture

Nov. 12<sup>th</sup> '23

Transitional Period 1145-1190

: Bristol; Glastonbury. 1184

Characteristics: interlacing arches; elaborate decorations; many mouldings on one arch; pointed as well as rounded arches.


1174 Canterbury Cathedral by William of Sens. Noyon, Soissons & Sens Cathedrals are very like Canterbury.

Corinthian capitals; pointed arches; vaulted shaft springing from top of pillar <sup>instead of round</sup>; sexpartite vaulting, (abacus square)



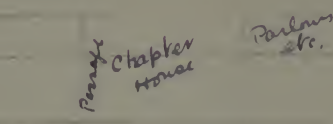
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paired <sup>columns</sup> capitals: French characteristics in  
Canterbury: Very English is the Purbeck  
marble for decoration; narrowness in width;  
zig-zag moulding.

Carlisle 1188 has a strange tower arranged  
upon 2 squares:  Also an ~~arcade~~  
continuous arcade, which has had to be propped up by  
2 stones.

Furness:

1147.

  
Cloisters  
Chapter House  
Parlour etc.

[Monks dormitories  
over Chapter House]



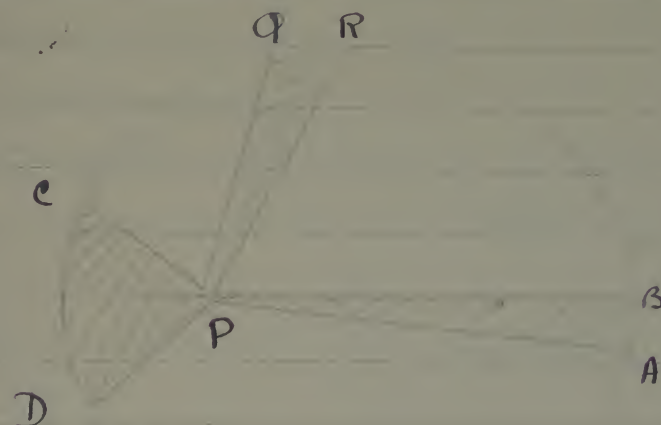
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i/p 38 cmc 147

Astronomy

Nov 13<sup>th</sup> 23

Earth moves at 18 m.p.s. Diameter of its orbit 186 <sup>million</sup> miles  
Line joining the a planet to the sun is called  
the radius vector.



Kepler

II A line joining the planet to the sun sweeps  
over equal areas in equal times. i.e. from  
A-B; C-D; R-Q.

III The squares of the periodic times are proportional  
to the cubes of the mean distances.  
for instance, taking Earth & Venus  
 $(365.3)^2 : (224.7)^2 :: 1 : (0.7233)^3$



1781 - Uranus - Herschel

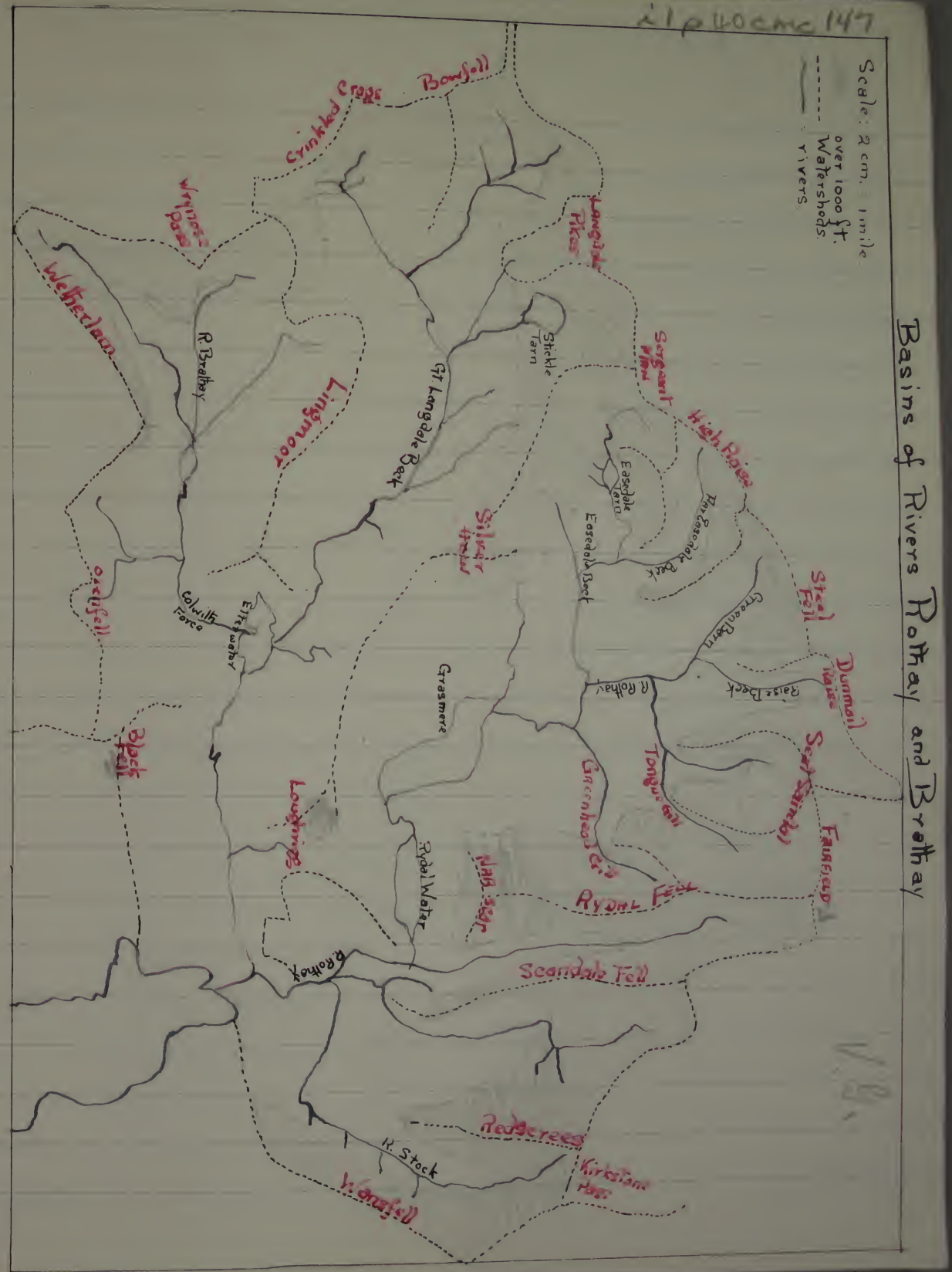
Jan. 1<sup>st</sup> 1801 - Ceres discovered by Piazzi in Sicily.

Bode's Law holds good except for Neptune.

Earth								Uranus	Neptune
0	3	6	12	24	48	96	192	384	
$\frac{4}{4}$	$\frac{4}{4}$	$\frac{4}{4}$	$\frac{4}{4}$	$\frac{4}{4}$	$\frac{4}{4}$	$\frac{4}{4}$	$\frac{4}{4}$	4	
4	7	10	16	28	52	100	196	388	300

If 10 represents the earth's distance from the sun, then Uranus is  $\frac{196}{10}$  of the earth's distance from the sun.

1846 - Neptune by Le Verrier & Adams. *FL*





## Natural History

Cryptogamia - from Kryptos - hidden & gamos - marriage.

Ferns are Vascular Cryptogams or Pteridophyta.

Fronds are divided into pinnae & those into pinnules.

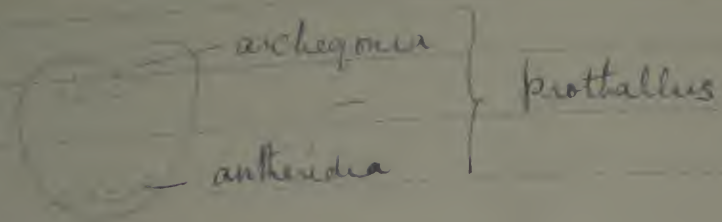
The Indusium is an umbrella-shaped cover over the sorus - or heap of spore-cases. The Sporangia (ion) or spore cases hold the spores.

Indusium  
— sorus.

On the Prothallus there are antheridia - or vessels holding the sperms & archegonia - or vessels holding the eggs. The only way in which a spore resembles a seed is that it is cast away from the parent plant to begin life on its own. The spore subdivides & forms a prothallus and fertilization comes afterwards. In the flowering process fertilization comes first. The archegonia when fertilized produce a fern plant. The sperms float down on any drop of water to the mouth of the archegonia, holding the eggs. Generally, the nourishment contained on the prothallus is sufficient only for the



development of one egg.



Special Spore bearing plants.

Parsley Fern

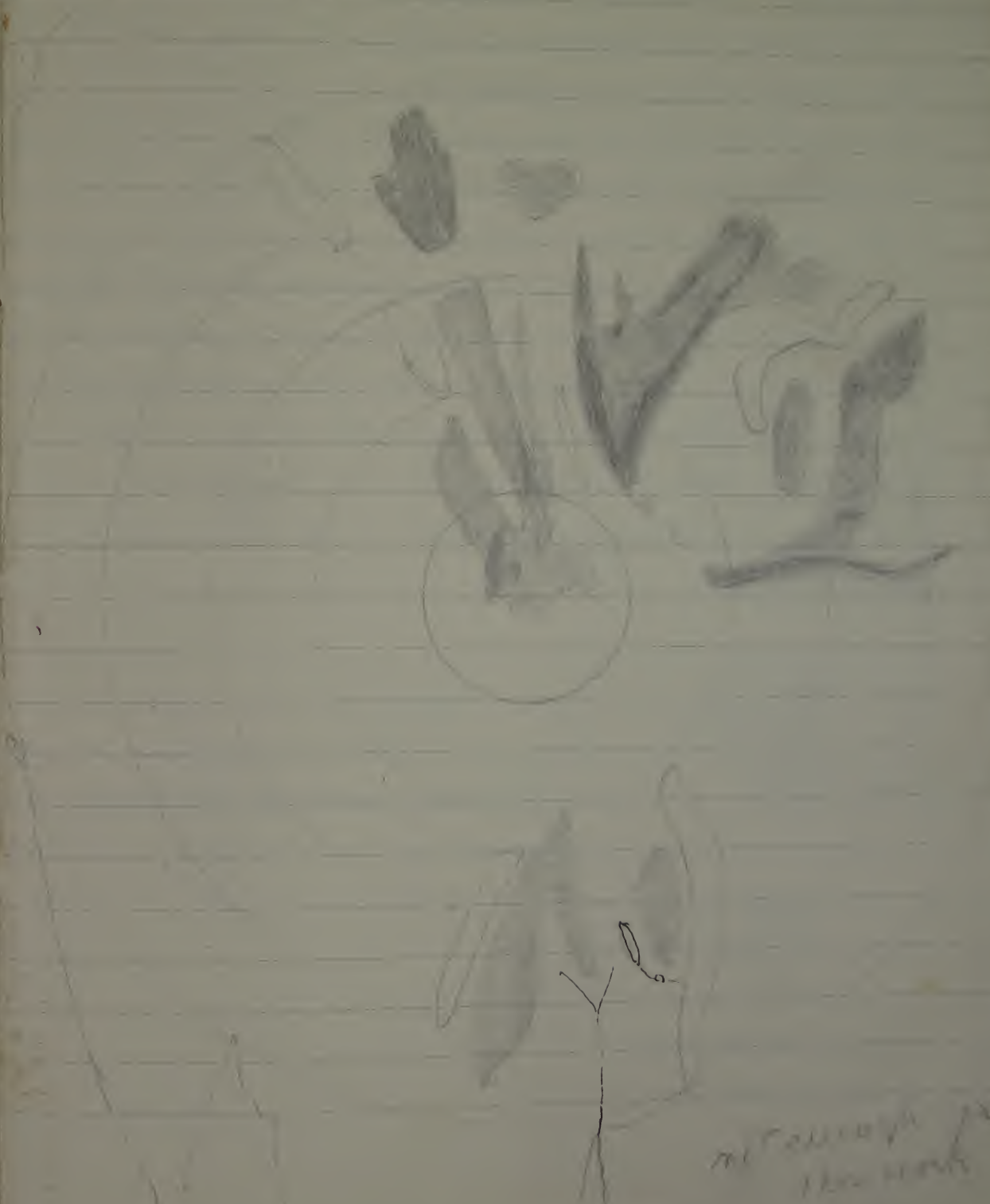
Osmunda (Royal)

Hurd Fern

Adder's Tongue

Moorewort.

Y.G.





i/p44mc147

Horsetail has an underground stem.

The leaves are placed in circles forming whorls \*  
The main stem is generally surmounted by a  
close set spiral of spore leaves. Spore-producing  
leaves are not branched. \* round the stem  
the branches are leaf like.

The flower consists of spore leaves often  
covered by several series of leaf-whorls which  
protect the sporangia. The spores have 3 cell  
walls. The spore forms a prothallium which  
produces either archegonia or antheridia.  
From the fertilized egg cell is made a new  
horsetail.



spore leaves.



showing a group of sporangia.



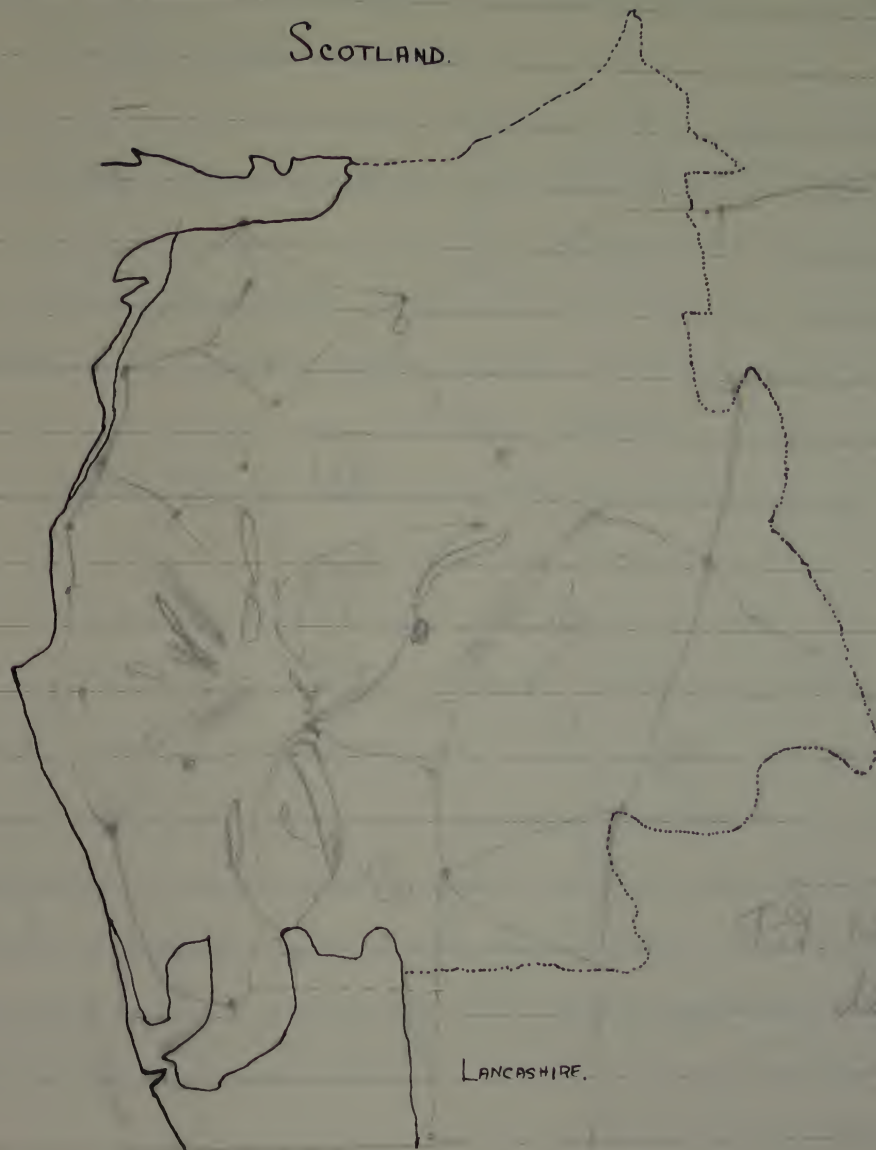
A spore with the elaters  
coiled around it.



uncoiled.

V. 9

i/p45mc147



P. 9. Needs more  
definite line



May 21 '22

Club Moss - Lycopodium

Lykos - a wolf  
Pous, podys - a foot

Gk.

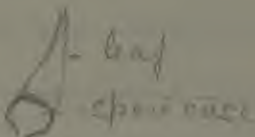
ilp 46 emc 147

Clavatum or  
Stag's horn club moss  
L. Selago - fir club moss  
L. alpinum

} Club mosses

Club mosses bear their spores on special  
little branches called clubs.

Longitudinal section  
of cone of club moss



The Selaginella ~~has~~ or Little Club Moss  
has spores of 2 sizes proceeding from spore  
cases of 2 different sizes. The lower cases  
are quadruple & the top ones are single  
The lower ones produce the egg cells & the top  
ones the antheridia to fertilize the egg cells  
This has been found not from tropical plants, & usually is carried on  
after spores have fallen to ground

micro-sporangium

macro-sporangium



Selaginella  
Longitudinal Section of  
Cone of Selaginella

Ferns

Club Moss

} Spore, prothallus { male  
female

ilp 47 emc 147

Horsetail

- Spore { prothallus - male  
prothallus - female

Little Club Moss

{ macrosporangium female  
microsporangium male

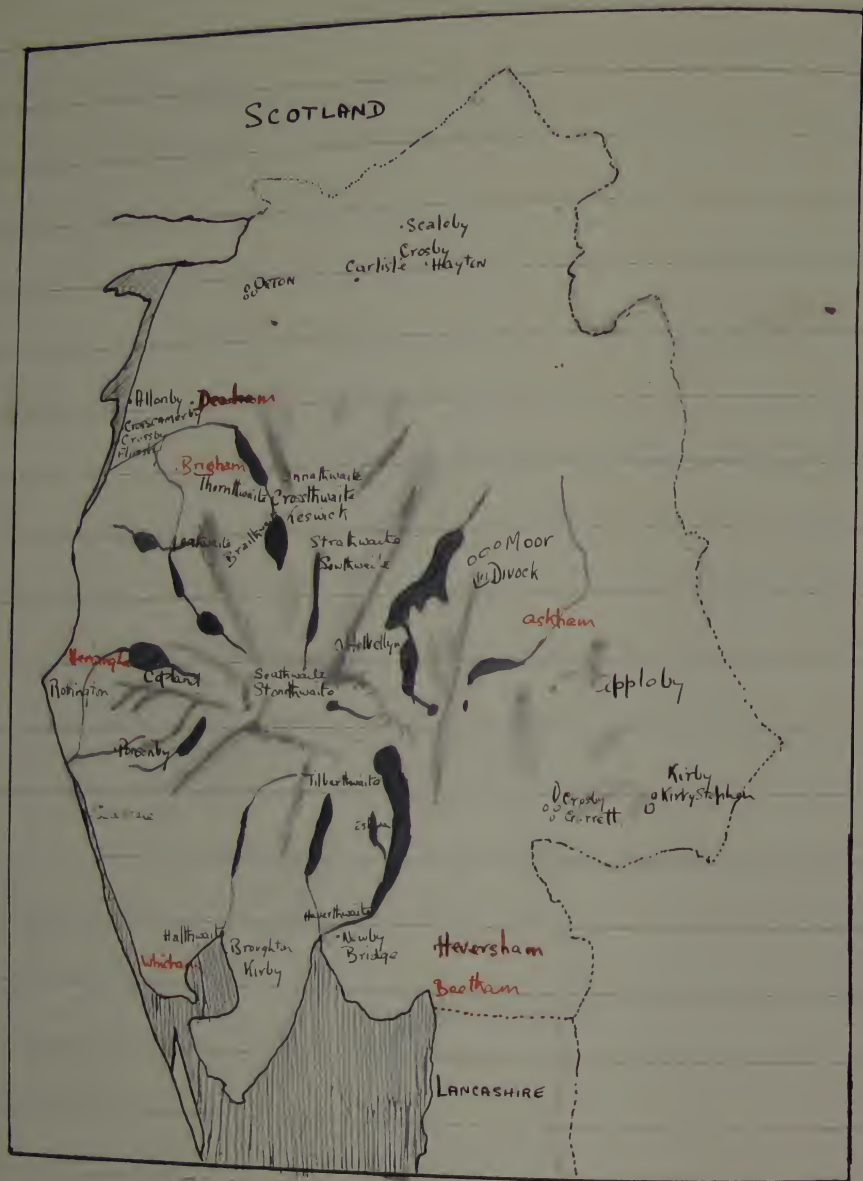
Vascular Cryptogams

} Ferns  
Horsetail  
Club mosses

are sporophytes or spore plants.



ilp48mc147



Good but no key

May 29<sup>th</sup>

ilp49 cmc147

Sweet Vernal Grass.

Differs from other grasses as it has proper flowers - staminate & pistillate in one inflorescence - spike. Stem is jointed at nodes. Leaves - linear, sessile, sheathing the stem.

Yellow Foxtail, & Wood Melick have many flowers in a spikelet (divisions on the spike) The vernal grass has only one flower in a spikelet.

also Common Bent, Reed Grass  
False Oat

Aira "Yorkshire Fog" have 2 flowers in a spikelet  
Grass grows quickly at internodes which are  
sometimes hollow - cane & bamboo.

edible grass seeds - oats, barley, corn, wheat etc.

Nearly all grasses have 3 stamens & 2 stigmas.  
Sweet Vernal Grass has 2 stamens & 2 stigmas.

Inner & outer leaves of spikelet = flowering  
glumes & palea awns - little bristles

Quonless

Owned

Poas.

Fescul

Yorkshire Fog.

Fortail

Common Bent

Sweet Vernal Grass.

Reed Grass

False Cat

Dog's Tail

Aira.

Wood Melick

Wood Melick



Meadow Fescue, meadow Foxtail, Dog's Tail, Rye grass, Cockfoot & Timothy are all useful

Silica or flint stiffen the stems of some grasses. So when they are beaten down by rain etc. they are able to erect themselves by means of their nodes at which they can bend at right angles.

(R)

### June 5<sup>th</sup> Mosses.

Grow in various places - rocks, barks of trees, running water etc. Those in running water are in long strands. Mosses grow in two ways - straight up & creeping: top fruiting or Acrocarpous; side fruiting or Pleurocarpous.

Roots of mosses are called rhizoids. Moss leaves have no epidermis. They are small & closely set, & the water runs up them. The leafy moss plant corresponds to the prothallus stage in a fern, & it produces antheridia & archegonia (sperm & egg cells).

Section of tip of male plant

— sterile branches  
— antheridia  
— leaf

The alternate generation consists of the seta (stem) & capsule. The capsule has 3 coverings:

1. veil or calyptra - seed coat, archegonia
2. lid or operculum
3. peristome - teeth - single or double row.

When the moss ripens, first of all the veil falls off & discloses the lid. The teeth regulate the scattering of the spores - closing in damp weather as the spores stick together & standing up in dry weather as the spores are as dust.

The Polytrichum (polus - many, tricha - hair) & its relatives have a white membrane connecting the its teeth.

### Names of Mosses

Crummia	} Tringe mosses
Racomitrium	
Tunaria	Cord or Screw Moss
Tortula	Screw moss
Bryum	Thread Mosses
Mnium	Thyme thread mosses
Polytrichum	Hair (or star) Moss
Fissidens	Hat fork moss
Ceratodon	Fork moss



ilp52cm147

Dicranum  
Hypnum

Broomfork moss  
feather mosses.

The moss spore produces the protonema. *not a prothallus because it bears several chloroplasts.*

Kinds of mosses:-

i. Sphagnales.

ii. Andreales (4)

iii. Bryinales or urn mosses.

(a) membrane

(b) single layer

(c) double layer - acrocarpous or pleurocarpous.

June 12<sup>th</sup>

Bryophytes { Mosses  
Liverworts.

In order not to confuse mosses with liverworts, the liverworts are divided into classes: ~~also, it is~~

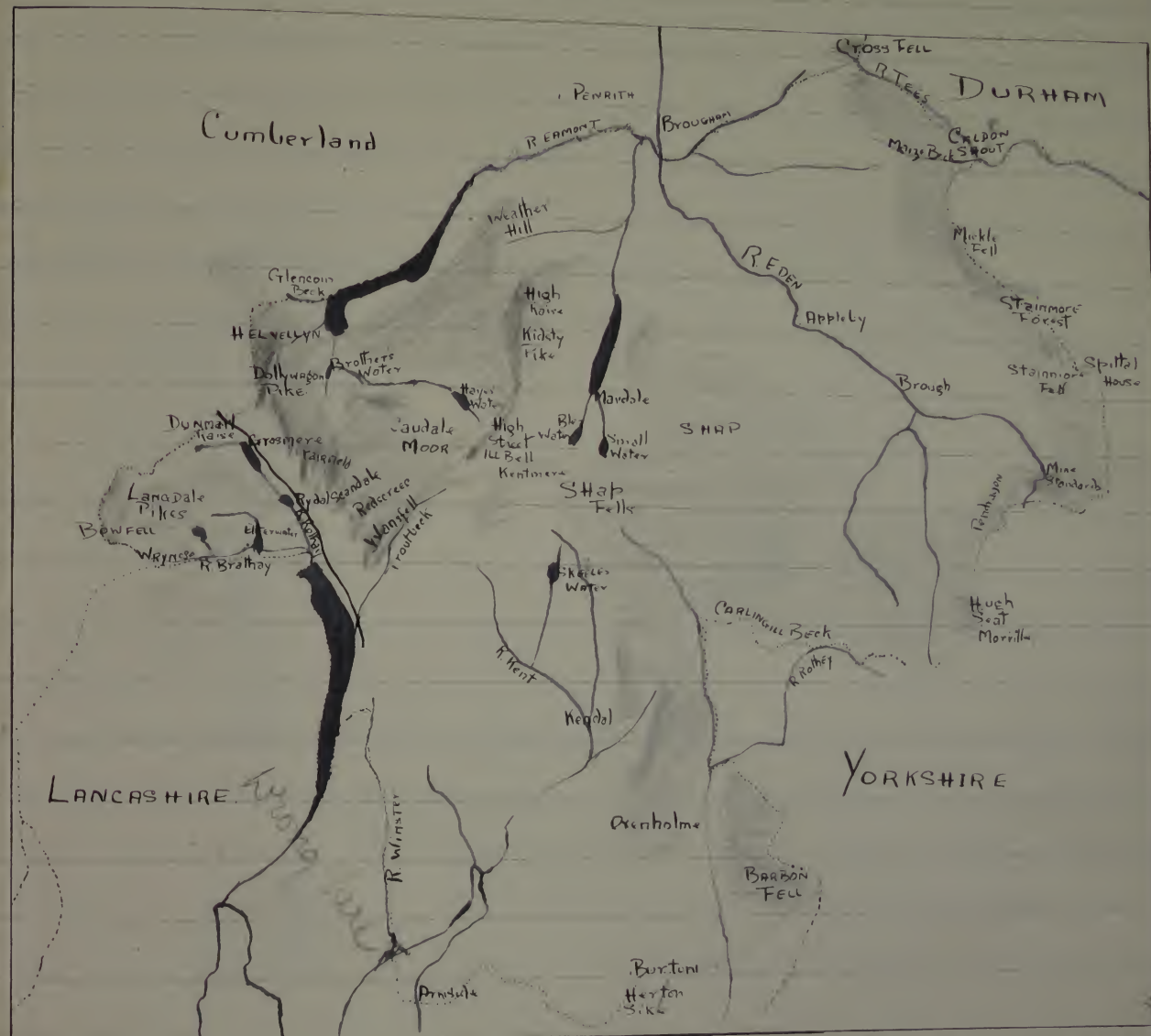
Frondose Liverworts

Foliose liverworts: - arrangement of leaves. Mosses are (very) difficult to press owing to the spiral arrangement of their leaves. In liverworts, the leaves lie right & left. The capsule splits into

ilp53cm147

The BOUNDARIES of WESTMORLAND

JUNE 10<sup>th</sup>



four; & the spores are mixed with the elaters.



ilp 54 cmc 147

The one exception in the mosses whose capsule splits into four is the *Andriaca petrophila*.

:-

The stalk of a liverwort is transparent & does not live after the spores are shed.

Receptacle

one arm of receptacle bearing archegonia.

Male plant of *Marchantia*.

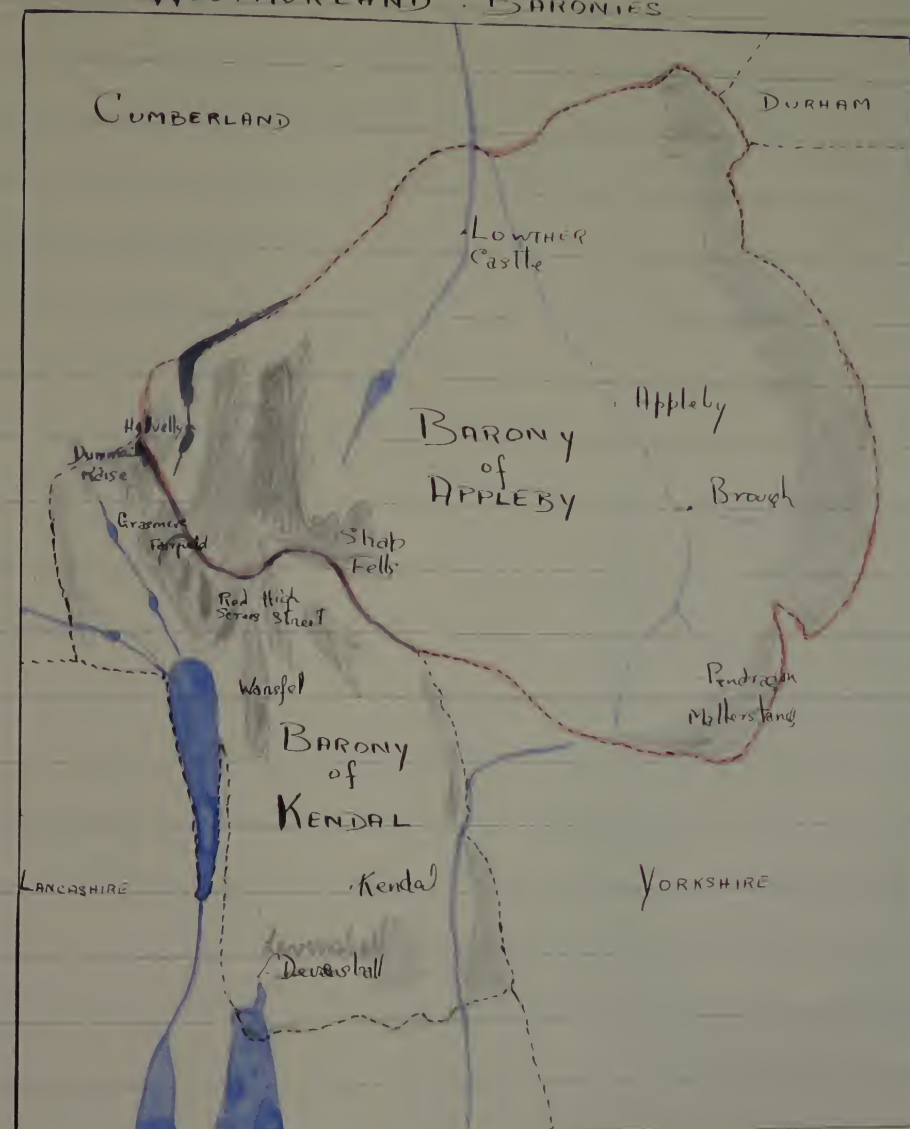
sunken antheridia on upper surface

male plant of *Marchantia* bearing antheridial receptacles Good

ilp 55 cmc 147

June 17<sup>th</sup>

WESTMORLAND : BARONIES

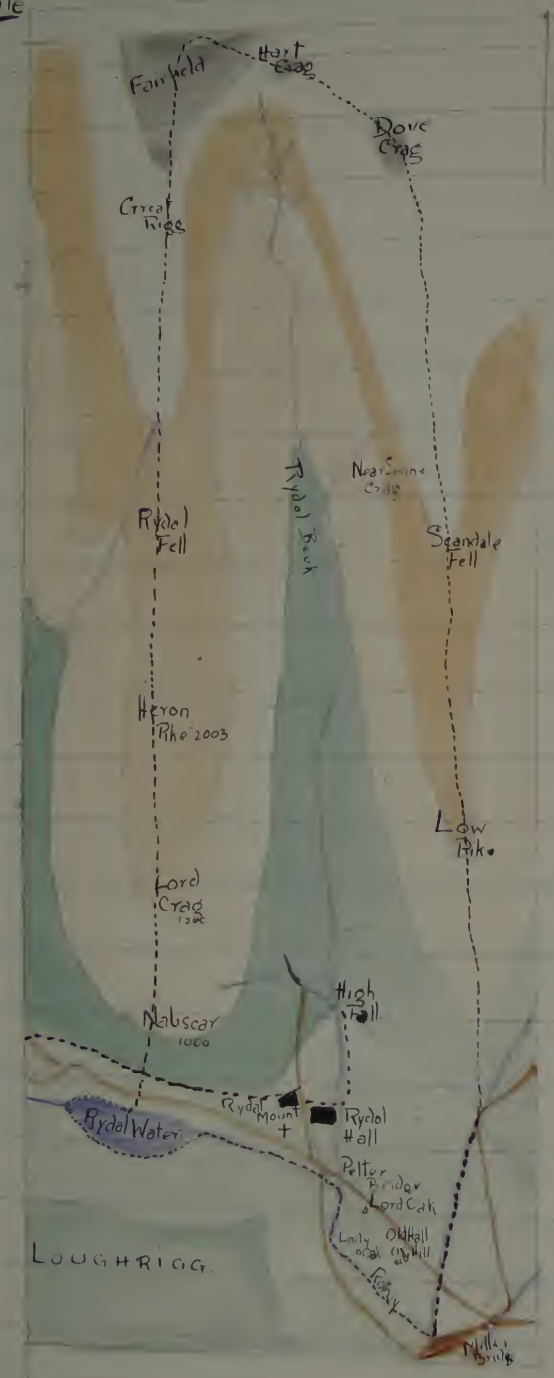




Manor  
Rydol Estate

ilp 56mc147

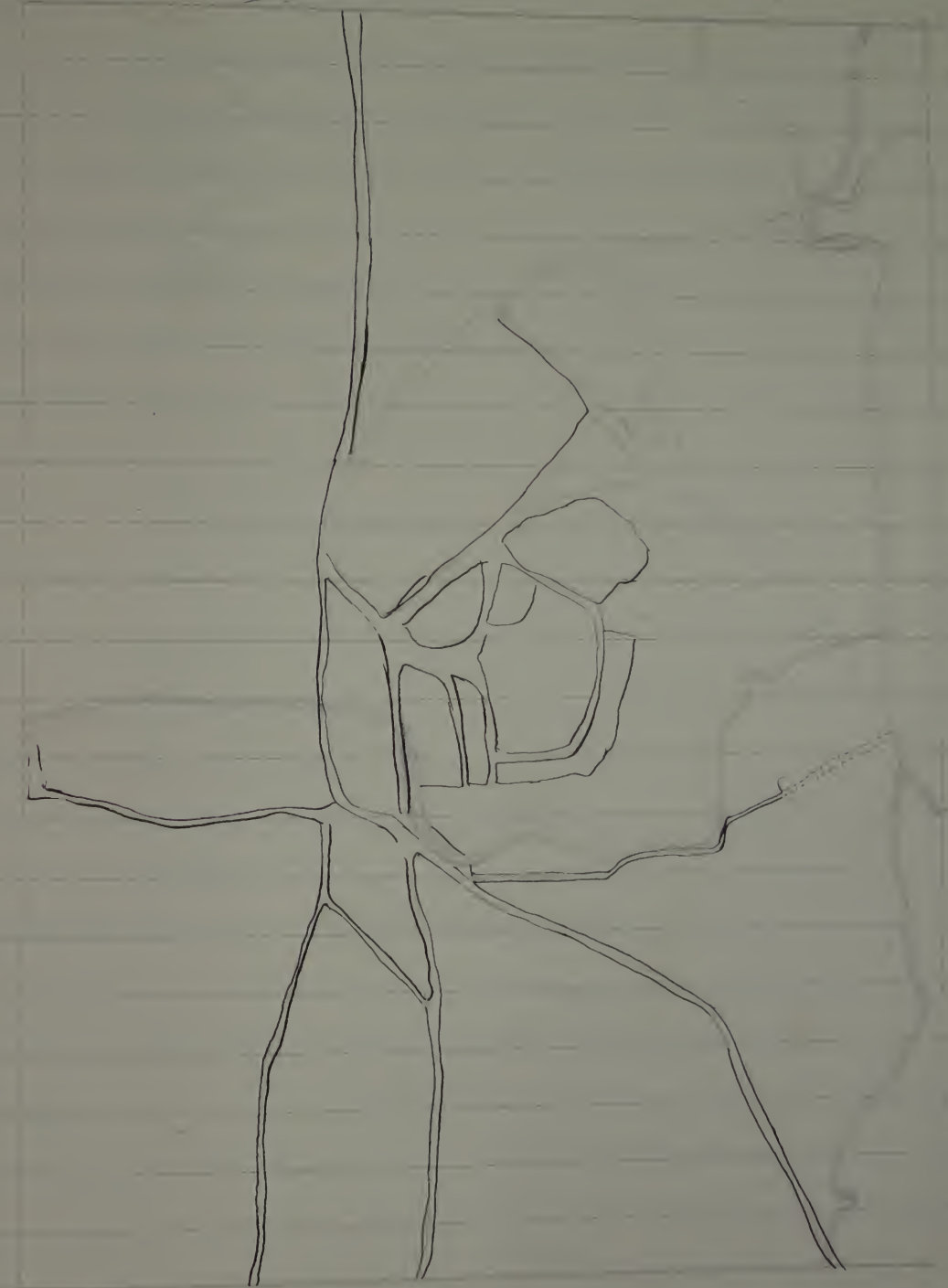
June 23<sup>rd</sup>



Good

AMBLESIDE.

ilp 57mc147



What will happen, what are they, one year ago if you had the mind to see them, would be it, such.



i/p 58 cmc 147

Recent deposits (those now in progress)  
 Alluvium, Raised beaches, River terraces, Blown  
 sand, Volcanic action, Peat, Cavern deposits,  
 Coral reefs.

Geology. i/p 59 cmc 147 Winter Term 1922

Appearance of Life	Systems.	Groups	Periods.
	Deposits in progress (recent)	Post Tertiary	
Man	Pleistocene Pliocene Miocene Oligocene Eocene	Tertiary	Cainozoic
Birds	Chalk Greensand & Gault	Cretaceous	Mesozoic
	Oolites, Clays, Lias	Jurassic	or
Mammals	Keuper Marls Bunter Sandstone	Triassic	Secondary
Reptiles.	Red Marls Magnesian Limestone	Permian	
Amphibians	Coal Measures Millstone Grit Carboniferous or Mountain Limestone	Carboniferous	
	Old Red Sandstone in most of England. Marine rocks in Devonshire	Devonian	Paleozoic
Fishes	Kirby Moor Flags Balmisdale Slates Conistone Grits & Flags Stockdale Shales Conistone Limestone Volcanic Series of Bowland Shiadow Slates	Silurian	or Primary
		Ordovician	
Invertebrates only	Grits, slates & shales	Cambrian	
"The Dawn of Life." (Region)	Rocks of many types Schists. Gneisses	Pre-Cambrian or Archaean	Eozoic.



ilp60 emc 147

New Red Sandstone Oct. 17<sup>th</sup>

New Red Sandstone is found on top of the Carboniferous rocks  
Buildings - Carlisle, New Liverpool Cathedral.

Natural History (other end) Elements.

Oct. 23<sup>rd</sup>

There are about 80 elements. Knowing the properties of the elements does not help us to know the properties of the compounds they form.

Atom from the Greek  $\alpha$  = not,  $\tau\epsilon\mu\eta\sigma$  = cut - something which cannot be divided. The smallest thing that the naked eye can see is  $\frac{1}{100}$  inch all ways. 3 or 4 million atoms could be placed in a line  $\frac{1}{100}$  long.

Molecule (moles = a heap  $\therefore$  little heap) - the smallest <sup>portion of a</sup> compound that is possible e.g. a molecule of water ( $H_2O$ ) is made up of 2 atoms of Hydrogen & one of Oxygen. This is chemical affinity - as far as the

ilp61 emc 147

Scientists of today can tell, whether the force is 'electrical attraction', is the same.

An atom is today known to be many, many particles revolving round each other like a miniature solar system or star with its innumerable smaller stars, revolving round it & giving the effect of one whole unit.

$N_2O$  = laughing gas.  $NaCl$  = salt.

<u>C</u>	<u>H</u>	<u>O</u>	
12	22	11	= sugar
6	10	11	= starch
2	6	1	= alcohol
3	8	3	= Glycerine
3	5	9 + N3	= Nitro-glycerine

A molecule may be composed of 2 atoms of the same kind - e.g. two atoms of C. gold, etc. As long as there are more than one atom present it is a molecule.

There are three states of matter & they depend upon the <sup>(cohesion - i.e. stick-2.)</sup> cohesion of the atoms. They are: Solid - liquid - gaseous.



Molecules of iron vibrate if the bar is hammered. It so becomes hot i.e. the molecules part; & we may join the broken bar & leave it to cool - i.e. the molecules again cling to each other. All solids are porous - they are composed of masses of vibrating molecules.

Good

## Geology

Oct. 24<sup>th</sup>

Colitis } Jurassic.  
Lias }

oon (gn) = an egg, lithos = a stone

The Lias are the lower layers of rock

Some stones of the Jurassic age very much resemble marble e.g. Parbeck, Portland & Bath Stone are ~~valuable~~ valuable for building.

William Smith 1790 - "father of Eng. geology."  
Tells kind of rock by fossils.

Some animals of the Jurassic age were the Plesiosaurs, Ichthyosaurus, Pterodactyl & Megalosaurus. The Archaeopteryx was the earliest birds with feathers, wings,

a jointed tail & teeth

Lias rocks are generally blue. There may have been a 'Sargasso sea' of sea-weed which would naturally stain them; or they may have been washed off from the coal measures.

Good

Oct. 31<sup>st</sup>

Chalk - North & South downs. ~~World~~ is the wearing away of the top of an anticline.

Also found on Salisbury plain & an arm goes to the North West going out to the sea at Hunstanton, & also at Flamborough Head.

(White Horse at Westbury, Wilmington Man. Salisbury Plain bare etc.)

Chalk rocks originally under sea.

Tertiary rocks or sands come on top of the chalk - The Thames basin & Hampshire basin (Eocene & Oligocene) The Pliocene up coasts of Norfolk & Suffolk. There are no Miocene ~~strata~~ in England.



pleion = more (recent forms) Pliocene  
 meion = less ( " ) Miocene  
 oligos = few Oligocene  
 eos = dawn, kainos = recent Eocene  
 From Eocene & upwards - dawn of recent life  
 discovery

[Chalk composed of millions of minute particles  
 of Globigerina]

Tertiary - gravel - such as London common  
 & Heaths & those of Hampshire - Aldershot etc.  
 New Forest to Poole & Lulworth

Stafford - Fingals Cave & Giants Causeway  
 - sheets of volcanic rocks of Tertiary age

Nov. 14<sup>th</sup>

Signs of erosion & deposition  
 { U shaped valleys & hanging valleys  
 { Roches moutonnees (rounded) & ice scratches  
 & blocs perches & erratics (both <sup>called</sup> boulders)

Moraines: terminal

lateral & median  
 a ground - boulder clay. = Till (very clayey)

## Minerals Crystals

21p 65mc 147  
 Dec. 5<sup>th</sup>

Mica



Fluor spar

Quartz

Calcite, rhomb-shaped. Has a good  
 cleavage: - breaks into smaller pieces of  
 same shape.

Minerals are classified into degrees of  
 hardness - Into ten degrees: -

1. Tale
2. Gypsum.
3. Calcite.
4. Fluor spar
5. Apatite.
6. Felspar
7. Quartz
8. Topaz
9. Corundum.
10. Diamond

A softer mineral can be <sup>scratched</sup> only by a  
 harder one. : Quartz will scratch Calcite, but not



2/P 66 cmc 147

vice versa. Thus we may test the hardness of minerals. There is also a simpler way: -  
1-7 It may be scratched by the finger nail  
1-6 " " " a knife.

Easter Term 1923. Astronomy. Jan 30<sup>th</sup>

Fixed stars are suns - i.e. ~~burning~~  
masses of burning gas.  
Number of stars visible to naked eye - 6,000.  
" " " through opera glasses 120,000  
" " " " largest telescope  
is 100,000,000.

In  $\frac{1}{10000}$  part of sky it is possible to see 16,000.

Our position in the universe

we are in the middle of the milky way  
which is the only cluster we can see with  
the naked eye.

Celestial Distances.

Pole star 32 light years away

If our sun represented a grain of  
sand the nearest star (grain of sand)  
would be 4 miles away.

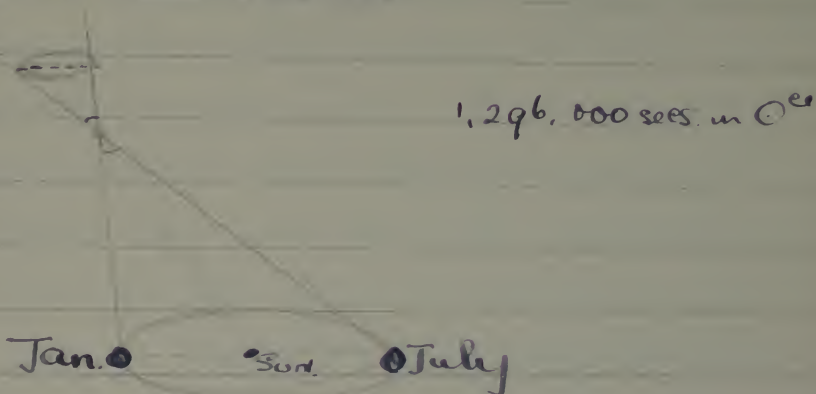
2/P 67 cmc 147

Sun - 93 million miles away.  
light 86,000 m.p.s

Alpha Centauri - next star -  $4\frac{1}{2}$  light years away  
How celestial distances are measured.

In measuring stars the base line of the  
earth's orbit is taken.

Parallax



Parallax is measured & vertically opposite  
angles measured. When with a base line  
of 186,000,000 miles, the vertical is less  
than a second, it is not difficult to grasp  
what an immense distance away the  
nearest star is.

An express train travelling at a continuous  
rate of 60 m.p.h. takes 5,000 yrs to travel  
from the sun to Neptune & 10,000 years to cross  
the breadth of the whole solar system.

8/11/23 for.



21p68cmc147  
Feb: 6<sup>th</sup> '23.

We see planets by means of reflected light from the sun & are much nearer to us than other suns.

### Proper motion of Stars.

The nearest star has appeared to move  $\frac{1}{2}$  the diameter of the moon in 200 years. Stars are travelling very quickly but they are so very far away from us that it makes no difference to us - e.g. the stars in the Great Bear are some rushing one way & some another & yet we see not the slightest difference from night to night year to year.

Some stars are travelling at the rate of 100 m.p.s. Our sun is rushing towards Lira at 25,000 m.p.h. It has been discovered that stars rush in one of 2 opposite directions. There is a star in the Great Bear called the Runaway Star or F 30 Groomsbridge, a star of the 6<sup>th</sup> magnitude which is

21p69cmc147

supposed to be travelling at the tremendous rate of 138 m.p.s. Vega & Sirius are coming towards us from opposite directions at 10 m.p.s. & Capella at 15 m.p.s. Castor & Pollux. Castor is receding at  $4\frac{1}{2}$  m.p.s. & Pollux is advancing at 33 m.p.s. & yet we see no difference.

### Size of Stars.

This is determined by means of the Spectroscope - by finding the amount of light given ~~together with the distance~~.

Magnitude - This is the size a star appears to be to us - its brightness. There are about 20 stars classed together in the 1<sup>st</sup> magnitude & each successive magnitude contains about 3 times as many stars of about  $\frac{2}{5}$  the brightness of the preceding magnitude. Thus - 1<sup>st</sup> magnitude contains 20 stars

2 <sup>nd</sup>	65
3 <sup>rd</sup>	190
4 <sup>th</sup>	425
5 <sup>th</sup>	1500
6 <sup>th</sup>	3200



Stars of the 16<sup>th</sup> magnitude are about the limit of those which can be seen with the most powerful telescope. Vega, Capella & Sirius are stars of the 1<sup>st</sup> magnitude. Sirius is  $2\frac{1}{2}$  times as bright as any other.

Feb. 13<sup>th</sup>

### Spectrum Analysis

By means of the spectroscope many things can be discovered. e.g. the temperature of the stars; the elements of which they are composed; the rate & also direction of travelling. The method of discovering the elements is this: gases in an incandescent state show dark lines on the spectrum. The arrangement of these dark lines indicates the presence of certain elements.

### Variable Stars

Algol is the chief variable star

Feb. 23<sup>rd</sup> '23,

### Temporary Stars.

Temporary stars are those which appear for a time & then disappear again. Two causes are put forward: 1. by the collision of heavenly bodies ~~they~~ <sup>new</sup> light is made; & 2. they become luminous by friction from rushing through the atmosphere.

1572. The most famous temporary star appeared in Cassiopeia in 1572. This was as bright as Venus in its greatest magnitude. It was first red & became afterwards like lead, like Saturn. This star lasted for two years & then disappeared.

1866. One in Corona Borealis of 2<sup>nd</sup> magnitude for about 2 days when it dropped to the 9<sup>th</sup>. It still is there now & therefore invisible to the naked eye.

1892. A yellow one in Auriga. Began in 5<sup>th</sup> magnitude & increased in size, but disappeared by August.



1901

21p72cmc 147

One of the first magnitude in Perseus. This was in February. After 2 days it lost a third of its brightness & varied between the 3<sup>rd</sup> & 5<sup>th</sup> magnitude for 6 months & then disappeared.

### Binary & Multiple Stars.

Cassini discovered a great many of these stars. There are now over 12,000 known binary stars. - Binary stars are two stars so close together that they appear as one.

Summer Term 1923.

21p73cmc 147

### British Insects.

1. Silver Fish. (*Lepisma saccharina*) one of the Bristle tails (λεπιδος - a scale)  
<sup>Sub.</sup> Order: Thysanura. Order: Aptera - without wings.  
 Consist of 14 parts - 1 in head 3 in Thorax, 10 in abdomen. True insects have 3 pairs of legs (from Thorax). Silvery scales. Called Bristle tail because tail has 7 bristles three being longer than the other four.

Silver fish

- antennae

Thorax

Abdomen

Bristle Tails

e.g. *Lepisma saccharina*

Camptodea

Spring tails

head - antennae, eyes, jaws

thorax - 3 pr. legs

abdomen

} segmented body.



Mouth parts of cockroach.

Labrum (upper lip)

Mandibles

1 pr. maxillae

2<sup>nd</sup> pr. "

Labium. (lower lip)

The Silver fish is like the larvae of the higher insects & it is thought that it is <sup>also like</sup> the probable ancestor of all insects, one reason for this belief being that the earliest insects <sup>probably</sup> had no wings at first, but grew them gradually.

The Silver fish is about  $\frac{1}{3}$ " or  $\frac{1}{4}$ " long. It frequents corners & wall paper & seems to have a great aversion to the dark. It is a typical insect in that it has the three parts head, thorax & abdomen, <sup>though</sup> it has no wings. The young are born with a great resemblance to their parents; during their life, they do not undergo very much change. They belong to the lowest class of insects, which changes the least in its attainment of perfection. Fairly good.

May 7<sup>th</sup>

Neuroptera

νευρον = a nerve

Alder fly  
lace-winged fly.

may flies  
dragon flies  
stone flies

Caddis flies

Scorpion flies.

The may fly lives only a short time above the water, the aim of its winged life being only to form & lay eggs. The may grub goes through a number of moults & when it is ready to come out of the water - having lived underneath about two years - it crawls up some water plant & after a few hours, is ready to flit <sup>above</sup> among the <sup>stream</sup> green until it



ilp 76 cmc 147

has laid its eggs, & then it dies.

The Caddis fly builds for itself a tube of little bits of twigs or sands & stones & lives in this during the underwater period of its life & this <sup>grub</sup> differs from the May grub in having a 'resting period' or chrysalis stage. About a fortnight before emerging, he closes the ends of his tube with silk & remains like that for a while so that water may get in but not other grubs. It then emerges from the water. It is rather larger than the May fly.

The Dragon fly is different from either the May fly or the Caddis fly in that it catches food both under & over the water. He is a very greedy fly! The larva gets food with his 'lip' - a mask over his face which is extended to catch a grub & brought back again to its mouth.

Good

chrysalis  
chrysalis  
chrysalis.  
larvae is plural

ilp 77 cmc 147

May 21<sup>st</sup> 1923

## Coleoptera

Kolletos: a sheath pteron - wing.

(elytra. false wings or sheaths)

Beetles. have three stages in their life:  
grubs or maggots (larvae)

pupae  
beetles

## Larvae

Campodeiform  
ground beetle  
carnivorous water beetle

eruciform  
(eruca: a caterpillar)  
tiger beetle  
cock chafer.

The female cock chafer burrowed down in the earth & laid about 30 or 40 eggs <sup>from</sup> which, after about five weeks, <sup>hatched</sup> turned into tiny white grubs which stayed underground for three years feeding on the roots of any neighbouring plants. Then it spun a little cocoon for a resting stage (or pupa) in which it

X. The report having described grubs in the plural with the word used the singular.



ilp 782mc147

remained for 6 or 9 months. Then it emerged the full grown cockchafer. Once <sup>it</sup> has his wings, a cockchafer can not grow larger. If the grub is small, so will be the beetle, & if the grub is small, the beetle will be correspondingly small.

Don't but you must take pains every with that. Just to use the same number throughout.

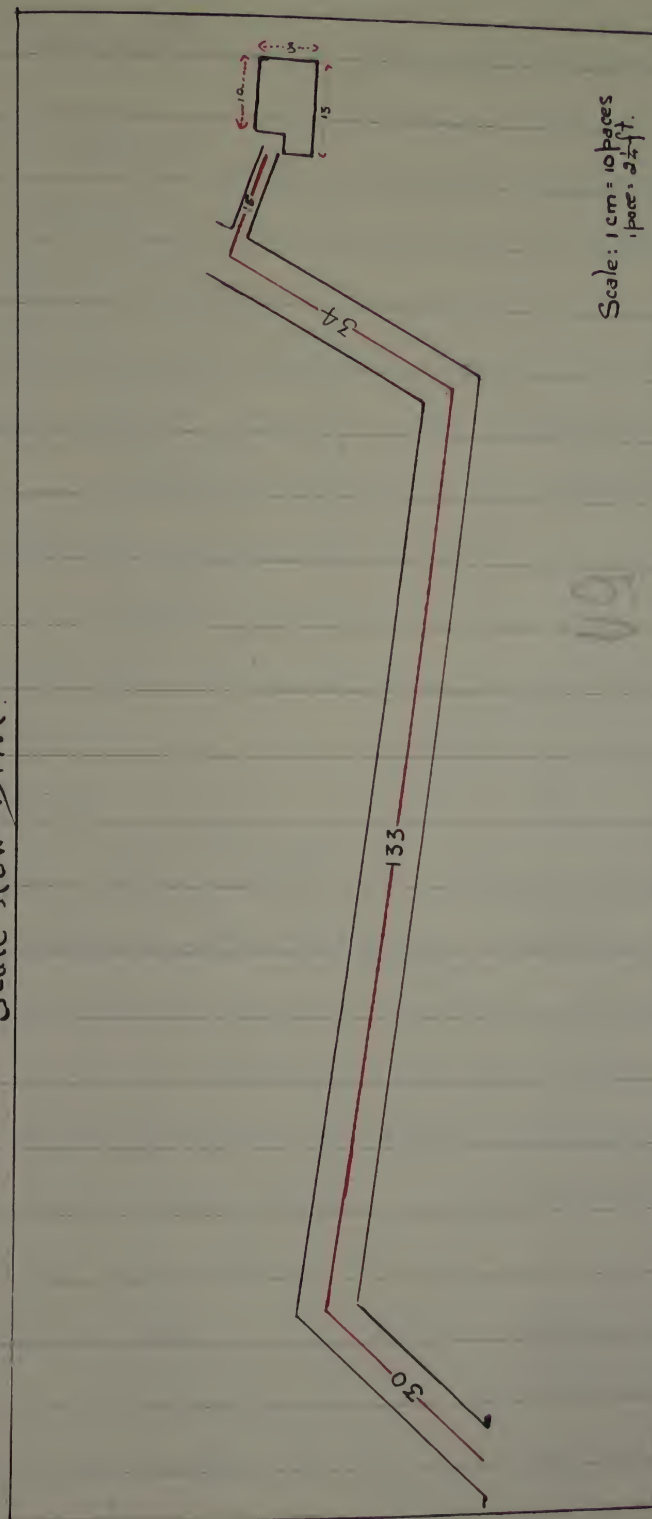
### Geography

Geography gives 2 notions: distance & direction. Direction we may judge roughly only by sunset & sunrise; but more accurately by measuring shadows before & after noon; by the pole star; & by a watch. (Place hour hand to sun, & S. =  $\frac{1}{2}$  way between hour hand & sun)

Distance we may gauge by pacing or measuring. The most convenient is pacing.

ilp 792mc147

Scale How Drive.



May 26<sup>th</sup> 1923.



21p80 cmc 147

Coleoptera.

May 28<sup>th</sup> '23

- Sub-order I Adephaga ex: Tiger beetle  
(ravenous) Ground beetle  
Carnivorous Water beetle  
Whirligig beetle
- II Clavicornia ex: Great Water beetle  
(club-horned) Rove beetle  
Burying beetle  
Lady bird
- III Lamellicornia ex: Chafers: e.g. Dung or Doi beetle  
(leaf-horned) Cock chaffer  
Bracken Clark
- IV Sericornia ex: Click beetle or Skip Jack  
(saw-like) Softskinned beetles eg Glow  
worms. Soldier & sailor  
beetles.
- V Longicornia ex: Pine long horn  
(longhorns) Poplar long horn  
Timberman beetle
- VI Phytophaga ex: Donacia (in water plants)  
(plant-eating) Dock beetle.
- VII Heteromera ex: Oil beetle  
(unequal-jointed)

21p81 cmc 147

Sub-Order VIII Rhynophora ex: Weevils eg Phyllobius  
(snout bearers). Fig-worm beetle  
Bark beetle  
(Scolytus)

Small Tortoise-shell Butterfly.

The Tortoise shell butterfly hibernates during the last stage of her life - i.e. the winged period, during the winter. The mother comes out of her hole in the wall or tree, & after a short flight, lays her eggs under the fresh green leaves of the nettle & then she dies. - Her wings after this long hibernation are faded & colourless. After about two weeks the caterpillars emerge from their eggs & spin a 'silken tent' on some leaf. All day they eat & at night return for rest; they have no need to pause for breath because they have spiracles or breathing holes in their sides by which they can take in air. They eat so much

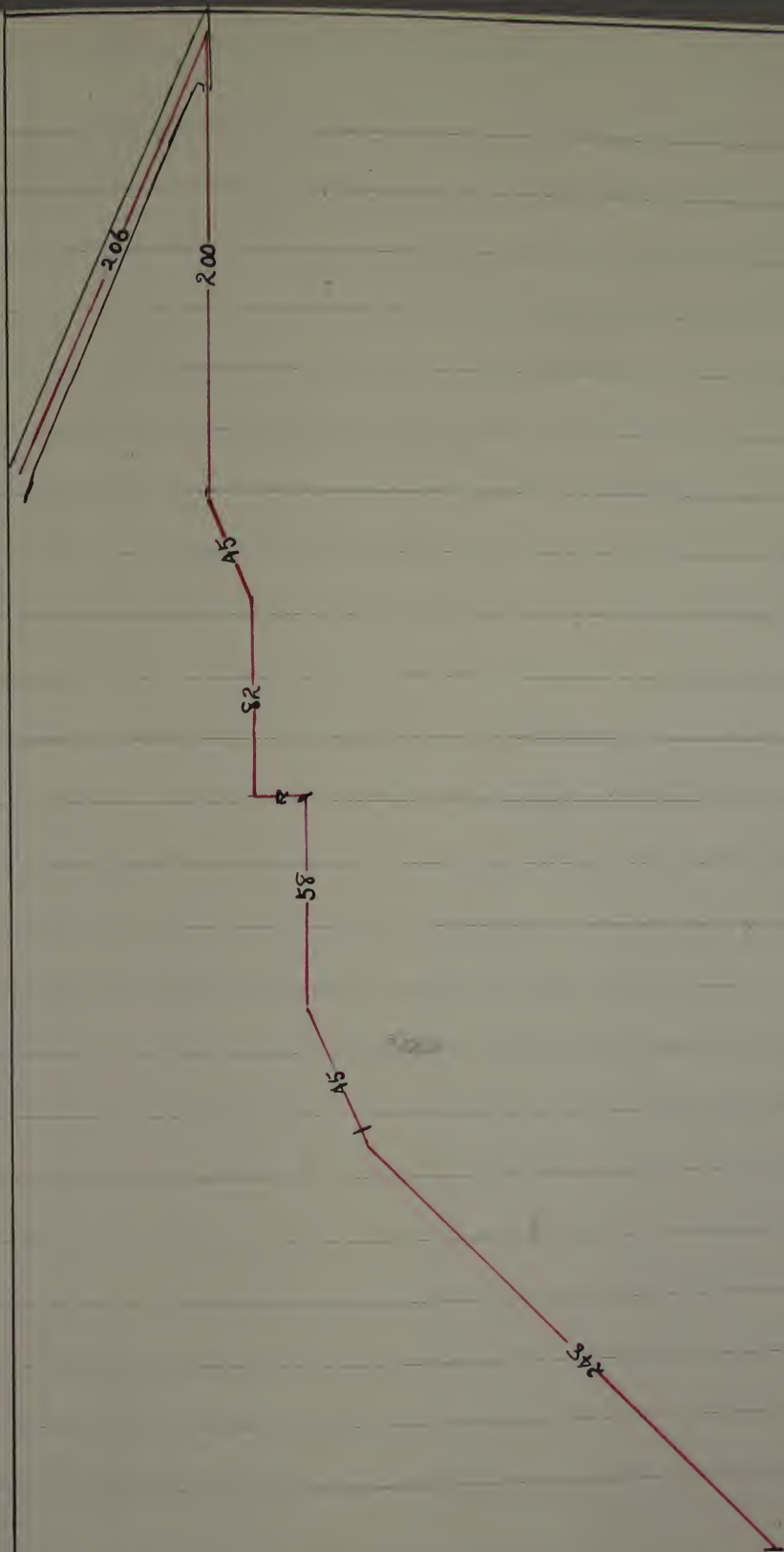


2/p82cm/47

that their skins fit tightly & so, contracting their muscles, they split their skins. This happens five times & just before the last moult is shed we may see the butterfly forming within & now there comes the resting stage during which changes in the mouth & nerves take place. The nerve system, formerly stretching throughout the body, now concentrates on the head, for the use of the large eyes of the butterfly. The chrysalis hangs downwards by means of cushion feet which are really folds in the skin. There are 3 or 4 hairs of true feet close to the head.

### Geography.

We also tell direction by the compass.



Scale: 1mm = 3 paces  
width of Stony Lane varies from 4 to 2 paces

Road from Scale How Gates & Stony Lane to Miller Bridge.

Excellent

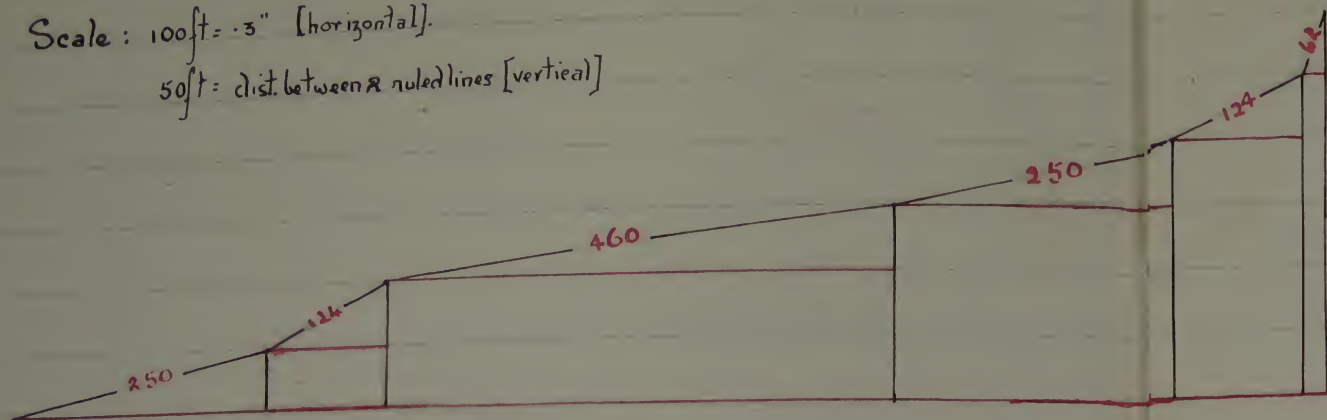


slp 84ema 147

June 9<sup>th</sup> '23.

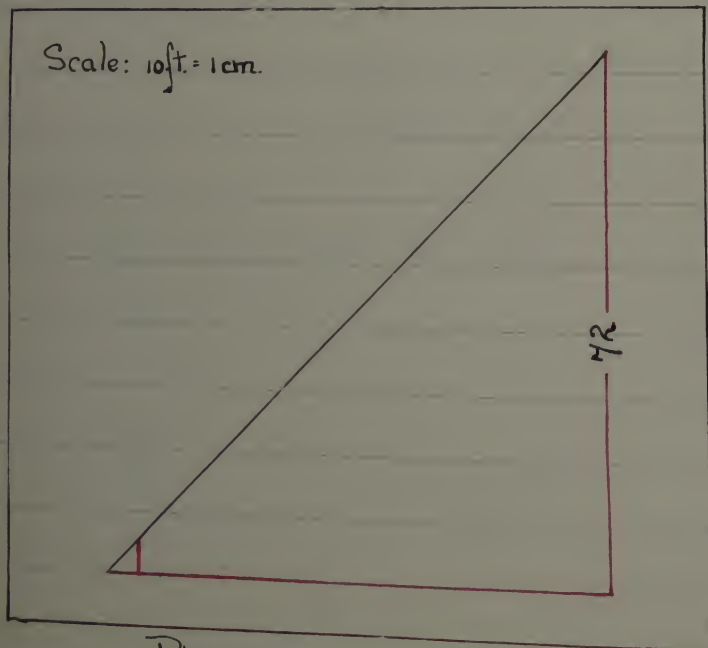
Scale: 100ft = .3" [horizontal].

50ft = dist. between 2 ruled lines [vertical]



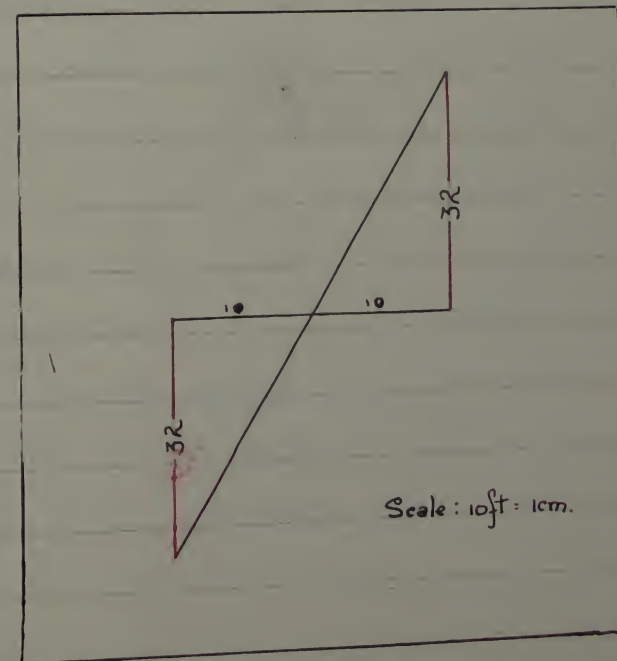
PLAN of LOUGHRIEGG.

Scale: 10ft = 1cm.



Plan of pine tree on right over small bridge. - Height.

Scale: 10ft = 1cm.



Plan of width of Rothay.

*Excellent*



ilp 85 emc 147

Lepididoptera

18715 = a scale

June 11<sup>th</sup>

Proboscis - 1<sup>st</sup> pair of maxillae

Butterflies

Club-shaped antennae

fold wings

waist

fly in day-time.

wings not linked

Moths

feathered, etc.

different position

broad body

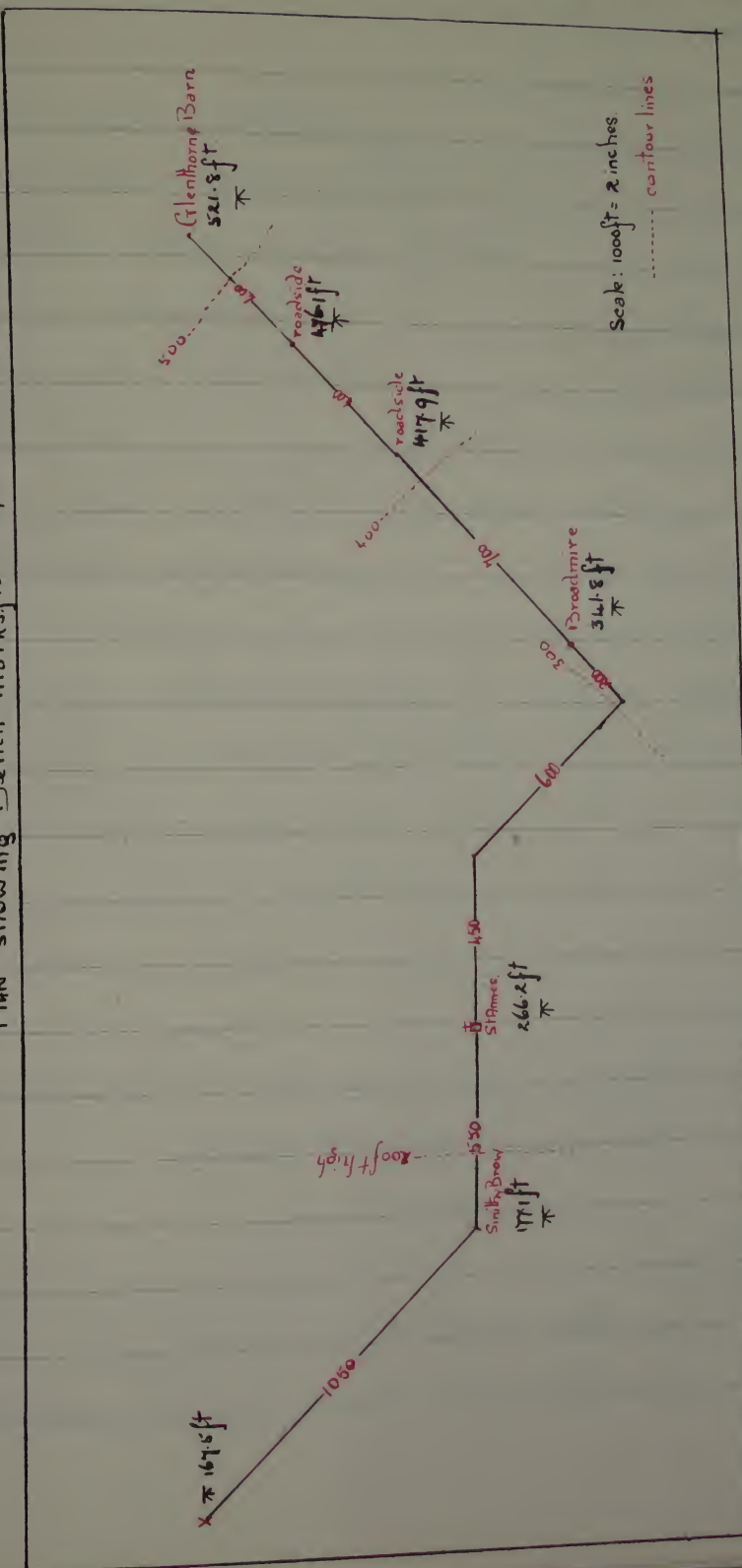
fly at night.

wings linked by a  
hook & loop.

Moths are more clever in their devices  
for self-protection than butterflies. The  
Sphinx <sup>caterpillar</sup> ~~moth~~ for example, will lie for hours  
motionless on a twig, to escape the ichneumon  
fly which lays her eggs in the caterpillar.  
When resting-time comes, the caterpillars  
burrow into the ground & weave a nest  
of silk to keep out the web; they remain  
here till June. *Good and 11 mottled*

ilp 86 emc 147

Plan showing Bench marks from Chapel to Glenhorne Barn.





## Diptera.

Straight  
seamed  
flies
   
 {
   
 Thread-like antennae
   
 Culicidae: Mosquitoes & Gnats.
   
 Tipulidae: "Daddy long legs" or Crane flies.
   
 Chironomidae: Midges
   
 Cecidomyiidae: Gall midges
   
 short antennae
   
 Tabanidae: Horse flies e.g. leg & great or gad fly.
   
 Asilidae: Robber flies e.g. Empis
   
 Bombyliidae: bee fly.

Circular  
Seamed  
Flies
   
 {
   
 Typical flies
   
 Syrphidae: Hover flies.
   
 Muscidae: { house flies, Blow flies, Flesh flies e.g. Lepto
   
 Cestridae: Gad & Bot flies
   
 Fleas

flies

egg

larva - legless grubs, no thoracic legs

pupa - longest stage.

The Gnat.

When the mother is ready to lay her eggs, she flies to some quiet water, gathers

her eggs together into a boat shaped mass with her long hind legs & deposits them on the water. Soon the eggs are hatched & the young grubs swim about, using some tufts of hair growing round their mouths to whirl microscopic animals & plants into their mouths. They swim head downwards & tail upwards, because they breathe through a small tube at the end of their tail which they put above water to take in air. During about a fortnight they shed their skins three times & after the fourth time they are shorker & unable to eat but still swim about. Also a curious change has taken place, the tail tube has disappeared & two tiny tubes have formed on their backs.

food

Geography Report

June 29<sup>th</sup> '23Lake Windermere

Lakes may be formed by basins of rock (formed) scooped out by glaciers, or by



ice forming a dam across a river bed. Windermere was <sup>made</sup> ~~formed~~ in the former way. The upper part consists of one rock basin, as far as the islands opposite Bowness. If the land here were raised 12 ft. we should be able to walk across on dry land! The deepest part of this rock basin is 219 ft., just opposite Wray. The <sup>lower part</sup> ~~foot~~ of Windermere consists of 2 rock basins, the deepest part of the first being 100 y of the second 128 ft. The second is made deeper by the <sup>glacial drift</sup> ice damming up at the foot. This dam also prevents the water from running straight out, as the lie of the country would permit, but causes it to turn & run down another valley.

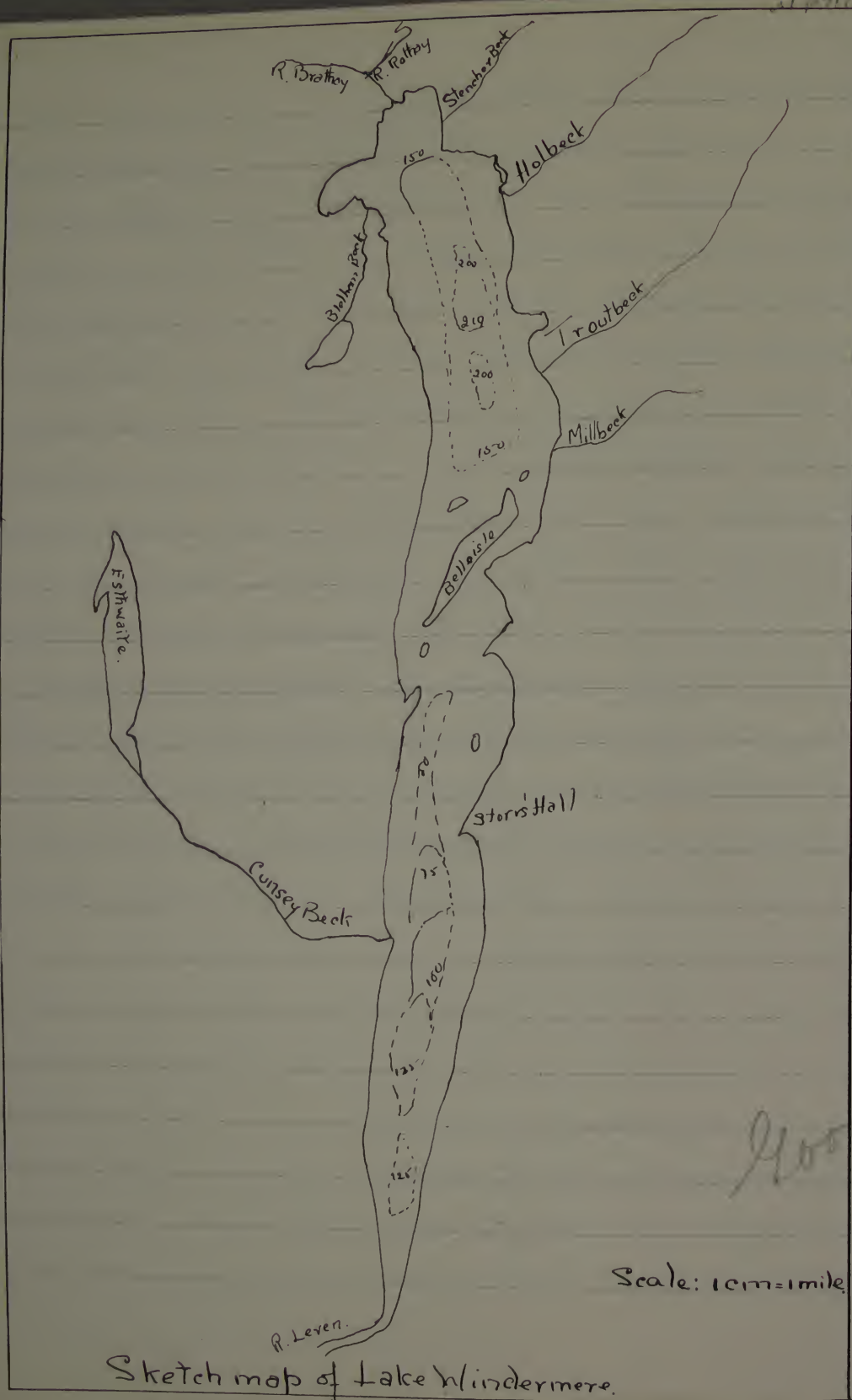
Windermere is called the 'River Lake'. It is of such even shape all the way down, that it might almost be a drowned river bed. But the absence of bays formed by tributaries denies this & also the large rock basins. There is only one drowned river bed & that is Pull Beck, which

forms Pull Wyke Bay.

Windermere is the largest lake in England. It is  $10\frac{1}{2}$  miles in length & the breadth varies from  $\frac{1}{4}$  -  $1\frac{1}{4}$  miles. At no place is it more than a mile wide if taken at rt angles to the axis, but at Pull Wyke Bay looking across to just above where the Holbeck runs into the lake it is  $1\frac{1}{4}$  miles wide. The surface is 128 ft above sea level. The average depth is 78.5 ft. In area it is ~~5~~ 5.69 square miles; & it drains the large area of 88 square miles.

Some of the tributaries are Brathay, Pullbeck, one from Belleham tarn, Cunsey Beck (from Esthwaite) Millbeck, Troutbeck, Holbeck & Skencher Beck.





1923.

Hymenoptera

4p92emc147

July 2<sup>nd</sup>

{ Saw flies  
Wood borers

Gall wasps

Ichneumons

Bumblers: Cerceris, Sphex, Sand wasps

Wasps solitary & social

Bees

Ants